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PLANTS & GARDENS
BROOKLYN BOTANIC GARDEN RECORD

Annuals, Perennials, Herbs, Grasses, Plant Combinations, Sources

42, NO. 1

PLANTS & GARDENS

BROOKLYN BOTANIC GARDEN RECORD

Beds & Borders

1986

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PLANTS & GARDENS
BROOKLYN BOTANIC GARDEN RECORD

BEDS & BORDERS

Vol. 42 1986 No. 1

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Cover photograph: A Border in Brooklyn Botanic Garden's Fragrance Garden by Elvin McDonald

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foreword

Barbara Perry Lawton

"In this garden every man may be his own artist without apology or explanation. Here is one spot where each may experience the romance of possibility, may give free rein to his fancy, and gather his living materials into compositions as gay, as splendid, or as wan as his individual enjoyment of colour dictates."
Louise Beebe Wilder, Colour in My Garden *(1927)*

Brick and boxwood maintain clean-line orderliness among the triangular beds of a formal herb garden. White fencing sharpens the distinction between these plantings and adjoining roses.

Barbara Perry Lawton, garden writer and columnist for the ***St. Louis Post-Dispatch,*** *is a long-time gardener and plant enthusiast.*

That remains as good a definition of gardening purpose as any I have seen. In the following articles, you will find inspiration for developing garden beds and borders, categories that encompass most planting endeavors. Garden beds, on the whole, are free-standing islands, such as those so well developed by Alan Bloom, the English horticulturist who has become one of the outstanding plantsmen of our time. Garden borders are longer than they are wide, and usually define an area, separate one space from another or line a wall or a building.

This volume touches on a number of subjects, such as herbs and plants for shade, that are more fully developed in other Brooklyn Botanic Garden handbooks. The purpose here is to expand horizons, to experiment with new ornamental plants and to develop your own personal gardening style.

Whether you start plants from seed or resort to well-established, field-grown specimens depends largely on the combination of your skills and plant availability in your region. While growing from seed generally offers the greatest variety, there are plants in both the annual and perennial categories that are difficult starters even for professional growers. You will find it easier to establish these from seedlings or containerized older plants. Growing from seed is the least expensive way to establish a garden but the most time-consuming. Mature containerized or field-grown plants naturally cost the most, yet they do offer the gardener a substantial saving in time. Your ultimate choice will be a compromise, as are most gardening situations.

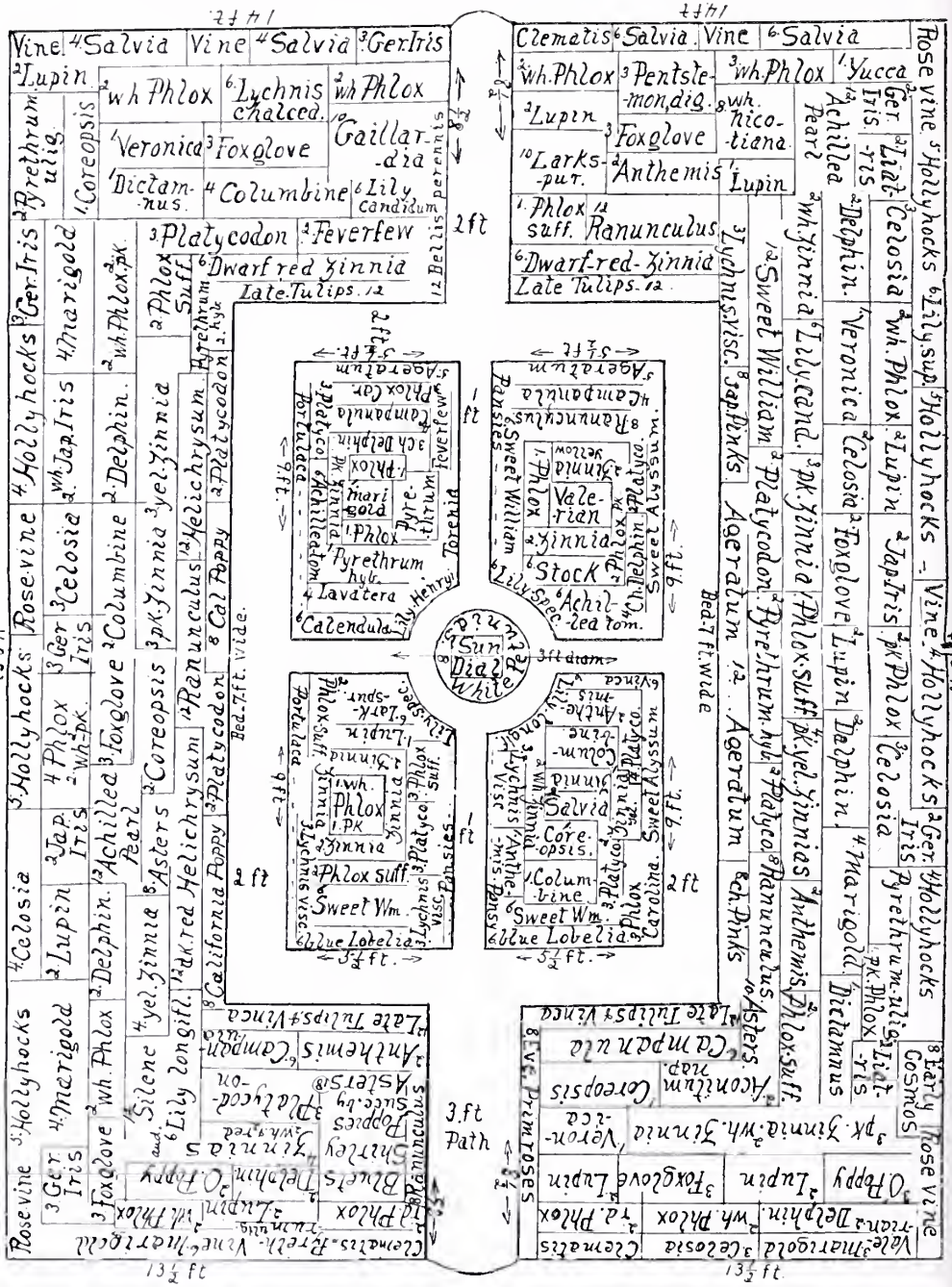
Remember that there is no such thing as a no-care garden. Indeed, I find that I move my perennials around in the garden much as others move furniture. Plants may grow too large for a spot or be the wrong color for a given situation, or you may simply tire of some that didn't turn out to be as successful as you had hoped. Treat the garden as a moveable feast, as an organic entity that evolves and changes in response to your own shifting moods and ambitions and the relative performances of your plant collections.

It was impossible in this overview to include in-depth treatment of all the plant groups appropriate for beds and borders. In addition to those covered, you will want to consider true lilies, daylilies, flowering bulbs, shrubs, small trees and ground covers. Don't let traditional practices curb your imagination; an edging of leaf lettuce, for instance, can bring great elegance to a small mixed bed or border.

North America offers gardeners a challenging variety of climate conditions, ranging from tropical to arctic. Some areas, including my own midwest section of USDA Zone 6, present both extremes just about every year. Trial and error is the old standby for determining which plants are suitable for a particular situation. But the information contained in this handbook will help you make the right choices at the outset.

Finally, don't hesitate to experiment, to try new plants in new locations. Garden centers and catalogs offer a seemingly endless reservoir of plants that are likely bed-and-border prospects. To have a beautiful garden, you need only give free rein to your innate senses of curiosity and dedication.

"The art of gardening consists in uniting the knowledge, understanding and love of plants with an equal understanding of the local environment," said Peter Smithers, two-time winner of England's Royal Horticultural Society Gold Medal, in a 1985 address at the Brooklyn Botanic Garden. We hope that this handbook will inspire you to pursue the art of gardening to its fullest, whatever your realm may be.


Sun Dial
White Pansies
Path
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Bed 7ft wide
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Hollyhocks
Lily sup.
Vine
Clematis
Salvia
Vine
Salvia
Yucca
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Lil. Celosia
wh. Phlox
Lupin
Jap Iris
pk Phlox
Celosia
Iris
Pyrethrum
pk. Phlox
Lil. Iris
Dictamnus
Cosmos
Early
Rose vine
Hollyhocks
Vine
Hollyhocks
Ger Iris
Hollyhocks
Rose vine
Celosia
Hollyhocks
Pyrethrum
Coreopsis
wh. Phlox
Veronica
Foxglove
Columbine
Lily candidum
Platycodon
Feverfew
Dwarf red Zinnia
Late Tulips
Bellis perennis
Phlox Suff.
Pyrethrum hyb.
Platycodon
Marigold
Delphin.
Celosia
Columbine
Coreopsis
Helichrysum
Platycodon
Cal Poppy
Ranunculus
Asters
Delphinium
Chrysanthemum
Late Tulips
Vinca
Rose vine
Marigold
Foxglove
Silene
Lily longifl.
Anthemis
Campanula
Blue Bells
Scabiosa
Ranunculus
Poppies
Asters
Platycodon
Pansies
Sweet Wm.
Lobelia
Phlox suff.
Lychnis visc.
Sweet Alyssum
Candytuft
Stock
Valerian
Phlox
Zinnia
Ch. Delphin.
Aster
Lily Henry
Torenia
Calendula
Lavatera
Pyrethrum hyb.
Phlox
Marigold
Achillea ptarmica
Campanula
Foxglove
Delphin.
Aconitum
Coreopsis
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Zinnia
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Marigold
Foxglove
Wh. Phlox
Delphin.
Columbine

Victorian *Beds & Borders*

No gardeners were ever more rabid about flowers and flower beds than the Victorians.

They filled every window in the house with flowers; edged paths, faced-down shrubs and covered walls with them. They invented greenhouses and rockeries for them, edged their yards with vast borders of them, pocked their lawns with paisley-shape beds and relegated the excess stock to pots and urns in doorways, paths, stairs, terraces and odd corners.

For their floral excesses, the Victorians were reviled by the generations of gardeners that succeeded them.

Certainly, their garden designs were sometimes loud, even vulgar. There is something jarring about having the lawn dominated by an immense, scrolled bed filled with ten-foot red cannas and ribbons of red, blue and yellow salvias, petunias and marigolds. But considering the tremendous changes the Victorians brought about, it is incredible that they didn't dream up something even more revolting. And considering what they accomplished, their excesses are quite forgivable.

Victoria Jahn, Manager of Plant Information, Brooklyn Botanic Garden, is also Landscape Consultant for Rotch-Jones-Duff House & Garden Museum, New Bedford, MA.

"Preserve in one or more places the greatest length of unbroken lawn that space will admit of."

From Suburban Home Grounds *by Frank J. Scott. John B. Alden, Publisher, New York, 1886.*

Presiding over a golden age in horticulture, the Victorians were not only responsible for filling beds and borders with a vast new inventory of flowers from all over the globe, they supplied the social, scientific and technological changes that made these flowers available to all gardeners—not just to a handful of wealthy patrons.

Before the Victorians, there were no lavish beds filled with a bewildering assortment of flowers, no mossy lawns, no perennial gardens of note and no annual borders. Gardeners struggled without pesticides, fertilizers, garden sprinklers, lawnmowers, greenhouses and seed catalogs. They didn't understand the mechanisms of pollination or natural selection. And, not surprisingly, few people actually gardened for the sheer pleasure of it.

Probably the biggest obstacle to flower gardening as we know it today was hauling water.

In the late 1800s pumping stations began providing cities with water under pressure. Not long thereafter, the garden sprinkler and hose were invented, and by 1880 were widely advertised in hardware catalogs and circulars. With the invention of the lawnmower in 1830, the stage was set for the American romance with lawns. Previously, lawns were infrequently wetted down and mowed with scythes. The resulting uneven stubble was not especially attractive and needed to grow quite long before it could be cut again.

By 1870 lawn mowers were widely available, and although they weighed 64 to 70 pounds, maintaining that picture-perfect greensward fast became a suburban obsession. *Henderson's Manual of Floriculture* favored the golf course look with a seed mix leaning heavily toward bent grasses. It

Early lawn sprinklers: cast iron (wood duck), N. Hyde Co., U.S., patented in 1931. Cast iron and brass lawn sprinkler, Allen Manufacturing Co., Chicago, Ill., ca 1910. Small brass lawn sprinkler, U.S., ca 1920. From Gardening in America, 1830–1910 *by Patricia M. Tice. The Strong Museum, Rochester, NY, 1984.*

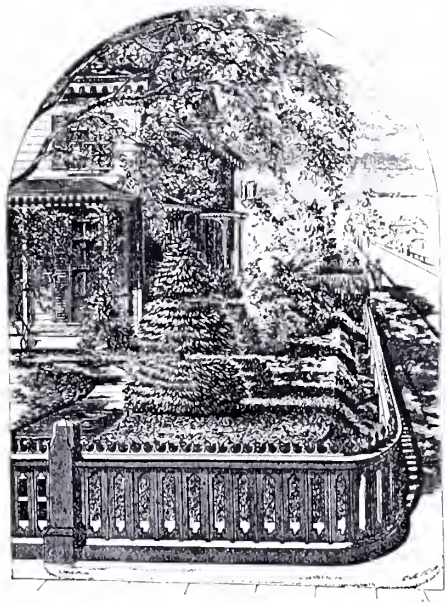
included: "12 quarts Rhode Island Bent Grass, 4 quarts creeping Bent Grass, 10 quarts Redtop, 3 quarts Sweet Vernal Grass, 2 quarts Kentucky Blue Grass, 1 quart White Clover." Once planted, the lawn required the fanatical ministrations of the homeowner if it were to continue to be a reflection of his level of horticultural expertise. A popular handbook of the day, *The Art of Landscaping Suburban Home Grounds of Small Extent* by Frank J. Scott, elevated mowing the lawn to a quasi-religious experience, a duty to be performed no less than once a week, as one inhaled the odor of freshly-cut grass. Weeds, of course, were to be "cut out like cancers."

Once the homeowner achieved the perfect velvety surface, it became the ideal canvas for showcasing his wife's highly individualized bedding schemes.

And what schemes they were! There seemed no limit to the Victorian appetite for extravagant flower-bed shapes, including:

With the invention of the lawn-mower in 1830, the stage was set for the American romance with lawns. From The Gardener's Catalogue 2, *Quill, New York, 1983.*

French curves, arabesques, tadpoles, circles, ovals and ribbons—all laid out in formal patterns. The beds were cut directly in the turf, using complex mathematical calculations and even more complicated layout instructions. (Imagine the domestic discussions after one



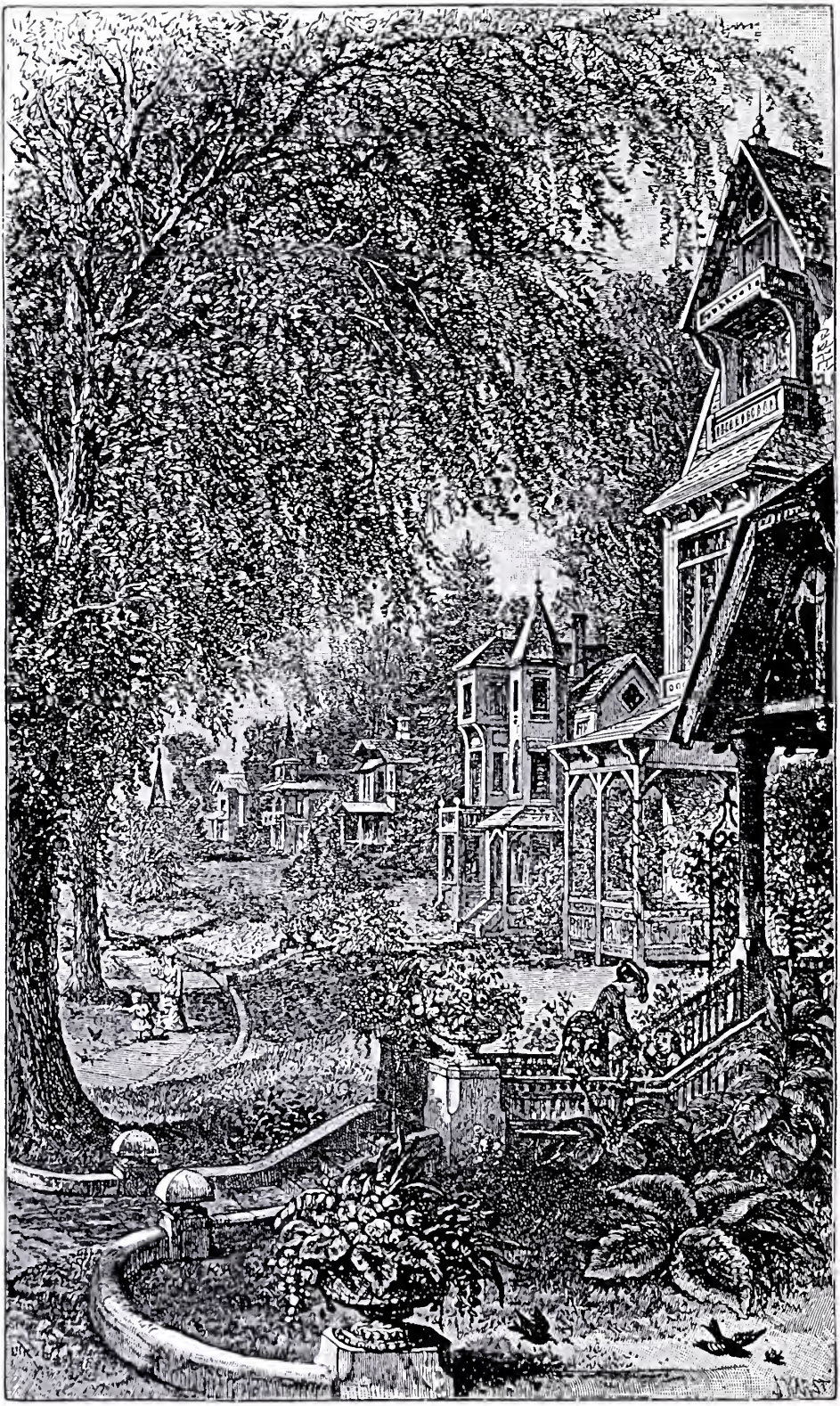
"It is always a difficult matter to keep the happy medium between extravagance and parsimony." From Suburban Home Grounds, *1886.*

spin around a tadpole with 67 pounds of lawn-mower.) If the finished design was pleasing, in addition to demonstrating the gardener's virtuosity—so much the better.

The fact that men as a rule rarely entered this emphatically female preserve is interesting. Perhaps they were too pooped after mowing the lawn and planting the more "serious" woody shrubs and trees.

Landscaping had always been a traditionally male endeavor. Most of the early 19th-Century horticultural and botanical books were written by men for men and were generous with advice on growing better fruit trees or the merits of new conifers from Japan. Flower gardening usually received a brief mention on the back pages, with a short list of perhaps 25 varieties of annuals or perennials to work from.

Notable exceptions were *Gardening for Ladies* and *The Ladies' Companion to the Flower-Garden*, both by Mrs. John Claudius Louden. *Mr.* Louden's *Gardener's Encyclopedia* was a popular mid-19th-Century guidebook both in his native England and in the U.S. but it barely touched on matters concerning the flower bed.



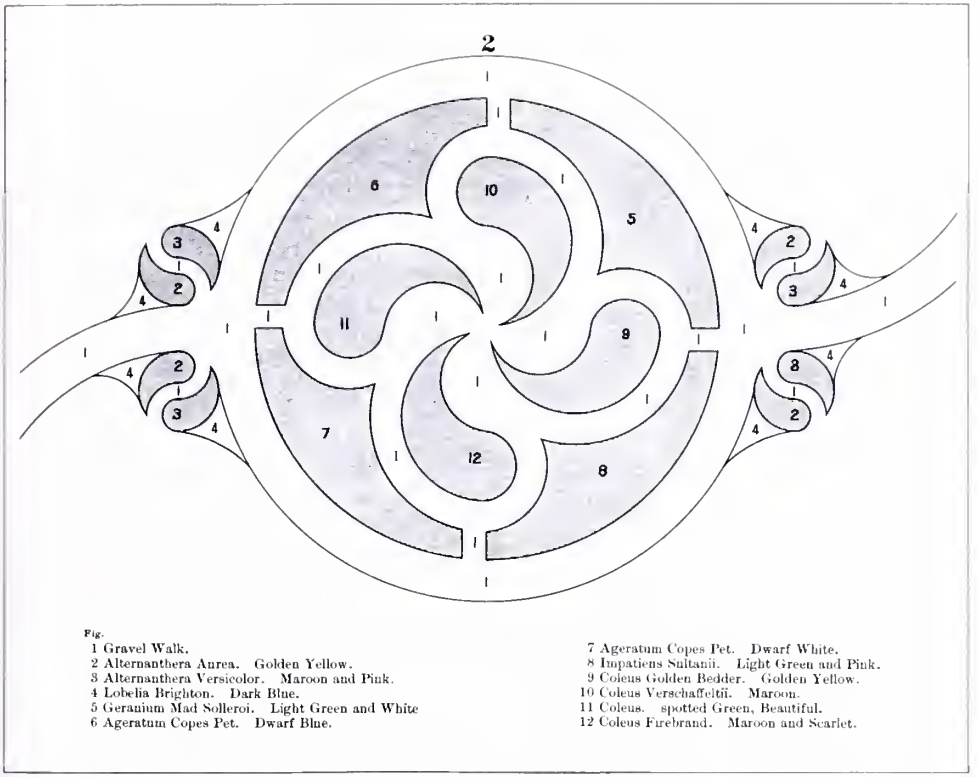


Fig.
1 Gravel Walk.
2 Alternanthera Aurea. Golden Yellow.
3 Alternanthera Versicolor. Maroon and Pink.
4 Lobelia Brighton. Dark Blue.
5 Geranium Mad Solleroi. Light Green and White
6 Ageratum Copes Pet. Dwarf Blue.
7 Ageratum Copes Pet. Dwarf White.
8 Impatiens Sultanii. Light Green and Pink.
9 Coleus Golden Bedder. Golden Yellow.
10 Coleus Verschaffeltii. Maroon.
11 Coleus. spotted Green, Beautiful.
12 Coleus Firebrand. Maroon and Scarlet.

Left, Victorian-era street scene resplendent with plantings. From Suburban Home Grounds, *1886.*

Above, from Designs for Flower Beds *by Wm. F Gale. Geo. A. Solly & Son, Publisher, Springfield, MA, 1887.*

Mrs. Louden filled the gap with information on "stirring the soil," manuring beds, culture of the most popular annuals and perennials and helpful hints on how to remain dainty while digging. Glaringly absent was any discussion of planting layout, complementary plants or working with color.

Perhaps it was because these things still had to be worked out satisfactorily. Thousands of new plants had been introduced from abroad and gardeners were still so absorbed by the mysteries of their exotic cultural requirements that they had little idea how to use the newcomers most effectively in their planting designs.

Although plant hunters had been bringing foreign exotics back to Europe and thence to America for over a century, it was a trickle compared to the flood of imports the Victorians demanded and struggled to shoehorn into their gardens after 1834.

Before 1834, plant hunters and botanists were lucky if even 50% of the plants they collected made it back alive. Plant collecting was a dangerous business. Elaborate expeditions with coolies, mule trains and chartered steamers would be out in the wilderness for weeks. The trip could involve hanging from cliffs or slogging through swamps.

When a likely specimen loomed out of the jungle, it was collected and carefully packed in a box for perhaps a long trip to the nearest coastline. During the journey the box would be opened, inspected and the plants culled many times. If the specimen wasn't reduced to a lump of slime, it was loaded onto a ship for Europe, where it then had to survive salt spray, no watering, overwatering, rats, insects and finally freight handlers.

John Livingstone, writing in a letter to the British Horticultural Society in 1819, estimated that for every thousand plants shipped to Europe, only one survived the trip. That *one* entered the country at a cost of over 300

A grass walk with sundial. From Hardy Perennials and Herbaceous Borders *by Walter P. Wright. Headly Brothers, London, 1912.*

Pounds Sterling, after calculating the enormous expenses of launching an expedition.

The fact that fuchsias, impatiens and salvias didn't end up costing an arm and a leg was due almost solely to a forgotten caterpillar in a jar.

Dr. Nathaniel Ward, one of England's then vast army of amateur scientists, had bottled the insect in order to watch it pupate and turn into a butterfly. Like many of us with moldy oranges in the back of the fridge, he forgot to take it out. When he finally remembered, alas, the caterpillar was deceased—but he had a rather nice little fern growing in the airtight jar.

Obviously, plants in airtight glass jars could survive—even thrive.

From this happy accident, Ward developed an airtight glass box expressly for shipping exotic plants. It was called a terrarium, and it was an immediate success. Soon even the most difficult tropical plant was able to survive steamship passage around the Horn or the Cape.

The floodgates were opened and in poured palms and pampas grass, calceolarias, salpiglossis, celosia, cleome, coleus, dracaenas, more dahlias, echeverias, fuchsias, salvias, pelargoniums, marigolds, verbenas and zinnias from torrid climes. From more temperate areas came lilies, tree peonies, bleeding heart, sedums, coral bells, yuccas, poppies, meconopsis. In fact, the Victorians were responsible for the bulk of our popular annual bedding plants and scores of perennials. Many of these have become so familiar we think of them as natives. But they are native to South Africa, South and Central America and the Orient.

Most came to American shores via England or France and entered the country through New York City where most of the nurseries clustered. By 1861 plants were being imported directly from the Orient, with Parson's Nursery in Flushing, New York, the first to receive a shipment.

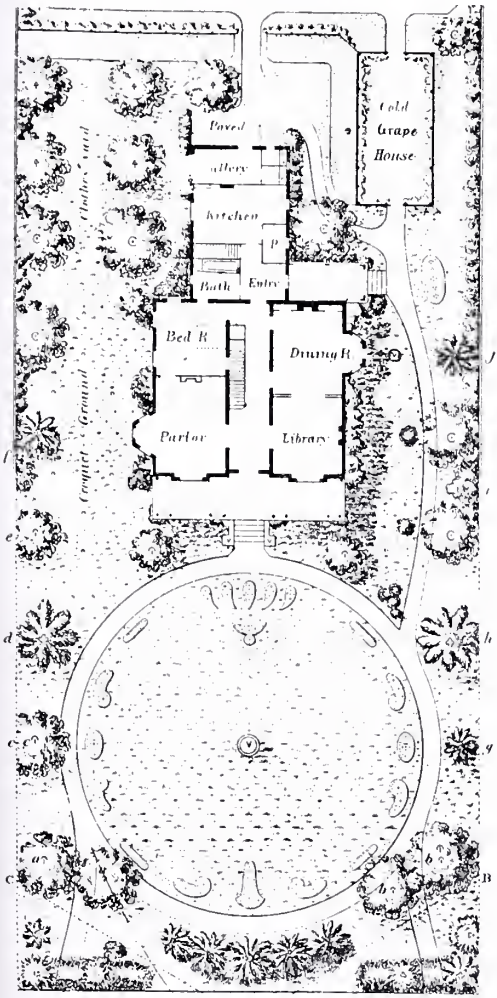
Parson's timing was impeccable; two other innovations were about to revolutionize the plant business: the color catalog and the greenhouse.

In 1864 James Vick printed what was probably the first American color seed catalog. Undoubtedly, gardeners, even then, were unable to resist the lure of unearthly pink and orange dahlias or tomatoes that rivaled melons in size.

With the inauguration of the postage stamp (1847) and delivery service (1863), gardeners' fates were sealed. No longer would they have to depend on traveling salesmen and their displays of hand-colored plates. Mail order was born. In 1872 Vick claimed his catalog had been mailed to 225,000 people.

Although the modern, all-glass greenhouse had just been developed in Europe, by 1840 commercial growers in America already had several thousand square feet of benches under glass. Anticipating public demand for the new tropical plants being brought over by explorers, they were quick to discern how important the greenhouse would become.

"A compact house, on an in-lot of ninety-six feet front, with ample depth, and a lawn connecting with adjoining neighbors." Scale: ⅛ inch = 1 foot. From Suburban Home Grounds, *1886.*



For the first time, greenhouses allowed nurserymen to grow and multiply previously "impossible" annuals and tropical foliage plants with unprecedented speed and precision. Now that science could explain the mystery of pollination, the stage was set for hybridizing thousands of annuals and propagating them cheaply and prolifically from seed instead of from cuttings.

This was fortunate timing indeed.

A boom in suburban building created a tremendous need for quick and easy plants to brighten up barren yards until newly planted trees and shrubs could make an impression on the landscape.

The building boom continued as the Industrial Revolution gathered steam and expanding middle and upper classes began to push out of the cities.

Ferries, trains and improved roads aided the exodus. With industrialization, the cities became unacceptable to the middle-class businessman's family. They were sooty, crowded, noisy, squalid and disease-ridden. Children did not have a safe place to play and wives were likely to get into mischief. The country life, while appealing, was a bit too rustic for the city dweller accustomed to paved sidewalks and gaslight . . . and too boring for wives at home with their children.

The suburbs were touted as the perfect solution: A haven from the hubbub of business and, paradoxically, a place for a wife to develop her interests.

Often, those interests included flower gardening.

At first, the flower border was approached tentatively.

Although upper-class women had been gardening for some time, they were really garden managers. They provided the ideas, while menial laborers—Mr. Spade, in one account—provided the muscle. This was a fine arrangement for planting trees and shrubs but scarcely suitable for fine-tuning color harmonies in an elaborate border. Elizabeth, in *Elizabeth's German Garden* (1897), solved that problem by sneaking out into the garden herself to dig a few holes—after making sure no servant could catch her in the act!

Eventually, women gave up this elaborate pretense and set about tending their own beds and borders in earnest.

Women garden writers appeared in print and exhorted their sisters to take up the trowel. Flower gardening was "preeminently a woman's occupation and diversion," declared Helena Rutherford Ely, author of *A Woman's Hardy Garden.* It was also a way to prevent insanity.

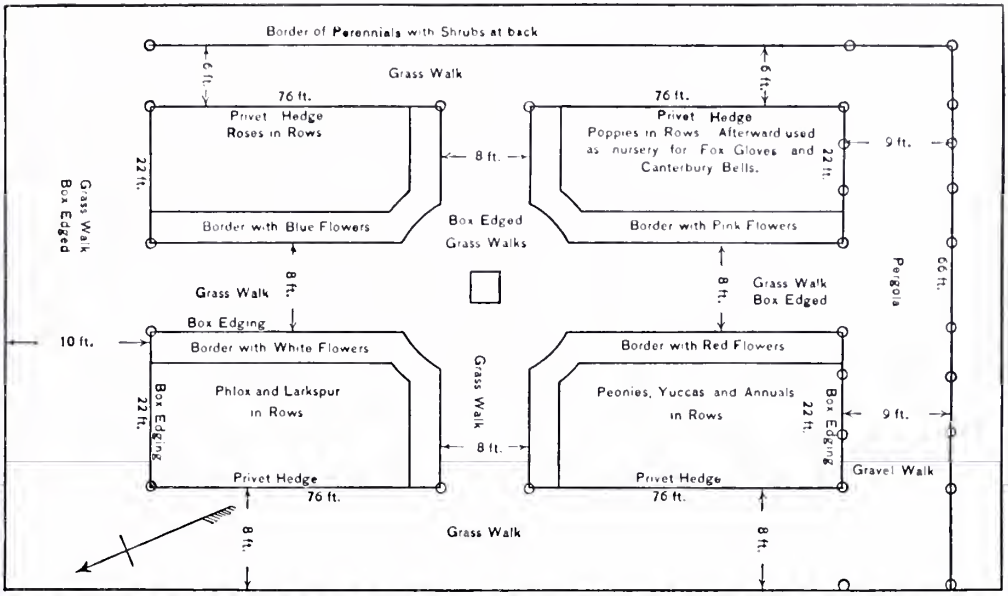
"If the rich and fashionable women of this country took more interest and spent more time in their gardens, and less in frivolity, fewer would suffer from nervous prostration," she asserted. As evidence that she practiced what she preached, her border plans were simple, symmetrical and staunchly lacking in frivolity. Only sensible, reliable flowers here: zinnias, rudbeckias, phlox (who didn't have phlox?), dahlias, centaureas and chrysanthemums.

It was a sentiment echoed by Frances Wolseley, principal of the Glynde School for Lady Gardeners in England. *Her* lady gardeners would "compete for prizes in tidiness and artistic arrangement of flower plots," and by so doing, keep away from the "gloom, squalor and temptations of large towns." In her book *Gardening for Women,* Frances explored strenuous subjects, such as trenching, composting and double-digging.

Obviously, to accomodate such decidedly un-dainty activities, the traditional "parlor" garden—usually sited along the front walk—had to move. The most logical place was the backyard and here the American suburban flower garden remains to this day.

Although Jessica Cosgrove wrote in 1925, her advice for placing flower borders reflects an earlier, Victorian sentiment: "Whatever the size of the lot, keep the part behind the house for your very best efforts. If you must have grass put that in front on the road, but where you work you want to be alone with your flower friends, not only for aesthetic reasons —for you cannot keep dainty very long if you really get down into the earth—but because the more you love your flowers, the more you will feel like withdrawing with them, and taking your friends especially to have their beauties carefully pointed out, rather than exposing them to the immediate and all-embracing gaze of the casual passer by."

For this point of view, if for nothing else, the Victorians must be congratulated. They revolutionized the prevailing attitude toward gardening, which held that gardens were little more than pleasant, living pictures in which one strolled about. The Victorian garden was a cozy refuge from the cares of an increasingly complex and hostile environment:



Left, summer bedding design. From Saturday in My Garden *by E. Hadfield Farthing. Doubleday, Page & Co., Publishers, New York, 1911.*

Above, a garden design from A Woman's Hardy Garden *by Helena Rutherford Ely. Grosset & Dunlap, Publishers, New York, 1903.*

A garden is a lovesome thing, God wot!
Rose plot,
Fringed pool
Ferned grot—
The veriest school of peace..."

In its confines the gardener could inspect, dig, coddle and show off his flowers in far more intimate style than previous gardens would allow.

No matter that the Victorians were perpetrators of some of the most bizarre floral excesses ever concocted. They were experimenting.

Gaudy tropical annuals rubbed leaves with dainty, pastel cottage flowers. Low-growing echeverias, sedums and antennarias were enlisted to create carpet beds with complex star, half-moon or ribbon patterns. Sometimes the beds spelled out a name in the lawn. Sometimes annuals were used to create the face of a working clock, its mechanism concealed beneath the bright blossoms.

In time, the excesses sorted themselves out. By the turn of the century, William Robinson and Gertrude Jekyll were urging restraint. Formal borders, although not quite "out" were not as desirable as the wild garden or perennial border. Nor were they as easy to maintain (a pitch that any modern perennial gardener would snort at).

Today, bedding out, carpet beds, herbaceous plant collections, floral clocks and the like have all but disappeared. There were minor resurgences during the growth of the suburbs (such as at the end of World War II), but mostly these elaborate dinosaurs are preserved in botanic gardens, municipal parks and amusement parks—all of which, it is amusing to note, were innovations of those incredible Victorians.

Floral clocks can still be seen in Montreal and Geneva. Elaborate beds and terraces continue to astonish visitors to Castle Ashby in England, Powerscourt in Ireland and Villandry in France. In America Mickey Mouse is enshrined in petunias at Disney World.

Perhaps cannas *would* be wonderful in the southeast corner of my yard. . . .Or maybe I should try Louise Shelton's border plan—reproduced here (see p. 6) in case any of you are likewise tempted. Do you think it's too ambitious?

Perennial Gardening

Alan Godlewski

Perennials are those plants that generally do not maintain woody stems from year to year, but return from persistent roots. Perennials can be mixed with woody plants in the landscape, they can be used alone in borders and free-standing beds and they can be interplanted with annuals.

Gardening with perennials is not a new art. It has been practiced since man's earliest attempts at cultivating the earth. Both in form and function, perennials constitute a very diverse group. They not only represent plants valued primarily for flowers, such as iris, peony and daylily, but include such practical herbaceous material as alliums, lavender, sage and thyme.

The ideal in today's modern garden is to use mixed plantings—perennials, annuals, shrubs and small trees. The advantages become apparent during the winter when the herbaceous border looks rather bleak. The best gardens provide interest throughout the year.

Alan Godlewski, Manager of Landscape Horticulture, Missouri Botanical Garden, was formerly Superintendent of Gardens at Filoli Center, Woodside, CA. *Photo by Pamela Harper*

Photos by Roche

Planning the Garden

The talent to design a beautiful garden is rarely combined with the ability to grow plants well, but each definitely enriches the other. One advantage in designing a garden is that plants are alive and flexible. They can be moved, discarded or increased, and the plan of the bed or border revised, as necessary, after planting. A perfect garden layout is seldom achieved in the first year, and there is much less trauma in changing the plan than there is, for example, in remodeling a part of the house. The major stumbling block is that the design must be a projection of the imagination, for it is impossible actually to place plants on location with all of them in full bloom.

Successful garden design is the result of input gleaned from many sources:

- Books, catalogs, films and other printed and recorded materials.
- Past experience (one of the most reliable sources of information).
- Observations made while visiting public and private gardens.

Four main elements play a role in garden design and in the ultimate success of the garden:

Light. Light is a prime factor in any design evaluation. The entire growing season must be taken into account. For instance, what may seem a lovely sunny space during much of the year is shaded in summer by trees in full foliage. Also, shadows from buildings, walls and other objects will lessen, to varying degrees, the amount of sun available throughout the year. Light for plants is usually described as:

Full Sun—direct sunlight touching a large expanse (meadow, open lawn, open terrace) the greater part of the day (a minimum of six to eight hours).

Half Shade—three to four hours of direct sunlight per day, usually concentrated in the morning or afternoon.

Shade—no direct sunlight, but enough indirect light to support some plant growth.

Deep Shade—low level of indirect light under heavily foliaged trees (horse chestnut, maples, beeches) where it is a limiting factor for plant growth.

Air Circulation and Wind Exposure. Open city terraces, on the one hand, are usually highly exposed sites where the wind factor is an essential consideration. A small fenced back yard, on the other, has limited exposure, but often poor air circulation as a result. Plants prefer something between the two extremes. Good air circulation, which

A stone walkway and trellis fencing define and contain a spring border of pansies, iris and peonies.

Opposite, spring border of dogwood and azaleas layers a profusion of bloom against a backdrop of woodland greenery.

Previous pages: A mixed border of perennials and annuals for seasonal color contains giant reed (Arundo donax), Tagetes *'Yellow Boy,' zinnias,* Rudbeckia hirta, Salvia *'Bonfire,' and* Helianthus *x* multiflorus.

White star flower (Ipheion uniflorum), *tinged with blue, grows from a spring-blooming bulb. Here it carpets the ground around an old tree, offsetting its gnarled trunk with splashes of color.*

helps alleviate disease problems and contributes to strong growth, is essential. Windbreaks of various kinds can overcome the problem of exposure. For areas of poor air circulation, the gardener has no recourse but to choose from a limited number of plants that are tolerant of the condition.

Soil. One of the most important factors in growing any plant successfully is soil, and of prime concern is its ability to drain moisture readily. If the soil of your prospective planting site always puddles after a rainstorm or if snow is slow to melt from it in the spring, seek another location.

Climate. Perennials, like other plants, are highly specific regarding the extremes of temperature they are capable of tolerating. Choose only from plants known to be hardy in your particular climate zone (see p. 64).

Two non-environmental factors relate directly to the quality of your garden:

Color. This is what the garden is all about. Before selecting a color scheme, consider all of the colors in the garden's surround, including the house, paving materials and the blooms of flowering trees and shrubs. Consider also the degrees of intensity of these colors. Herein lies the "art" of gardening, so well espoused by such greats as Gertrude Jekyll, who designed borders as if she were creating an impressionistic canvas. She unified a garden space by adhering to a single color scheme — predominantly white flowers, green and gray foliage, with some soft lavender added here and there, for example.

Choose flower colors that are pleasing to you. Place them in masses rather than in teasing touches, and tie them together with a continuous flow of one color. Of course, this is much easier to describe than to achieve, but by using perennials, bulbs, annuals and biennials, there will be color in the garden most of the time.

The goal of continuous color can be achieved through careful choice of plants. Color in spring is provided by hardy bulbs. Begin with the earliest, such as galanthus and winter aconite, followed by crocus, daffodils and tulips. Companion materials might be Japanese witch hazel, cherry trees and crabapples. Select next from woodland wild flowers, such as trilliums, hepatica, bloodroot, hellebores and bluebells. Early perennials — alyssum, candytuft, forget-me-not and bleeding heart — follow close behind. These pave the way for iris, peony and Oriental poppies. Roses then flower in harmony with lilies, baptisia, phlox, astilbe, coneflower and many others. By this time, annuals are also in bloom. The splendor continues with asters and chrysanthemums until the onset of frost.

Texture. Not to be overlooked are the variety of contrasting textures offered by the foliages of perennials. These run the gamut from the softest and furriest to the feathery to the harshest and most prickly to the ornamental grasses. No design is complete without consideration of the esthetic possibilities of mixing and matching these forms.

Photo by Roche

Soil Preparation

Soil is the most important factor in gardening. Well prepared, it allows abundant root growth and supplies nutrients. When soil is "worked" deeply, roots have an easier time pushing down, resulting in strong growth. Deeply rooted plants have access to underground moisture, which is vital during times of drought.

Garden soil has four essential components: water, air, mineral and organic matter. The balance of these contributes to tilth (well-being, richness) and friability (how crumbly the soil is). Ideally, soil is approximately 50% air and water, 5% organic material and the rest parent mineral matter (from the finest clay to the coarsest sand). The basic mineral character of any soil is virtually impossible to change, but soil quality can be amended as a result of preparation efforts.

Few suburban or city gardens have soils with adequate organic matter. A readily available and excellent soil improver is dead leaves. In the autumn, rake fallen leaves into the bed and work them into the top five-to-six-inch layer of soil. Soil microorganisms will decompose the leaves before cold weather sets in. If you have no compost or leaf mold available, substitute a three-to-four-inch layer of peat moss. Moisten before mixing into the soil, or the peat will act as a wick, absorbing water rather than augmenting the moisture already present. An application of several inches of aged manure — dried, processed manure may be substituted — will also work wonders.

Well drained soil, of vital importance, is such that water penetrates rapidly without sitting on the surface. Avoid situating the flower bed in areas that do not drain well. Use these locations for shrubs and other plants that tolerate wet roots.

While digging the bed, apply a fertilizer, such as 12-12-12, at a rate of two-to-four pounds per 100 square feet. It is also wise to check the soil pH. You can buy a pH testing kit at most nurseries. A pH level between neutral (7.0) and slightly acid (6) is ideal for most perennial flowers. A pH in the 6-to-5 range, which is moderately acid, is best for woodland flowers, azaleas and rhododendrons. Apply lime at a rate of three-to-four pounds per 100 square feet to neutralize too-acid soils. Use an acid-type fertilizer to help turn around soils that are too alkaline. Iron sulfate, ammonium sulfate and even agricultural sulphur will also increase soil acidity. Organic matter, such as oak leaf mold and peat, or cottonseed meal, are acid-encouraging materials that are less likely than chemical additives to result in plant damage.

The above recommendations refer to the creation of new beds, but the same directions apply if you are merely revamping pockets in the bed or border. When dividing perennials, never replant the division without renewing the soil first.

Planting

Perennials are generally sold in fall and spring. Plant in spring those that bloom in the fall, and plant in fall those that bloom in spring. However, containerized stock, so widely available today, can be planted out

In a Maine garden, an edging of sweet alyssum softens the transition from lawn to bloom in a border planted with feverfew and phlox.

Photo by Roche

virtually any time of the growing season. Plant perennials so the crown is at ground level or slightly higher. This keeps water from standing at the crowns and helps prevent rotting in winter.

Maintenance

Once the garden is planted and the first new shoots begin showing, the die is cast. Tending the garden thereafter can be enormously pleasurable and the best prescription for built-up tension. Well cared for plants are almost always healthy plants. If you choose specimens that do not have disease or insect problems at the outset, spraying will not be necessary.

In the spring, remove mulch and protective boughs, along with winter debris. When forsythia begin to bloom, most of the harsh freezing of winter is over and spring chores may begin. Fresh air and sun will dry off the crowns, and this is the time to cultivate ever so gently. A light application of liquid fertilizer at half strength is also in order. As green shoots begin to emerge, thin such plants as asters and phlox. Cut selected stalks at ground level. If too many stalks are allowed to remain, growth will tend to be spindly. Begin pinching asters and chrysanthemums. This practice produces more flowers per plant and greatly improves the overall show.

A neatly trimmed hedge of gray, feathery foliaged santolina frames a border of dahlias with complementary texture and color.

Photo by George Taloumis

Watering

As rainfall tapers off, watering becomes necessary. Always water deeply, not just a sprinkle over the surface. Deep watering encourages deep rooting and promotes drought tolerance. A soil soaker is a good way to water, and so is a fan-type lawn sprinkler, which approximates rain. If poor drainage is a problem, then to avoid mildew and such diseases as botrytis (flower blight), do not water, but allow plants to draw solely on available ground sources.

Grooming and Staking

Grooming is a continuous process. Remove yellowed and browned leaves and spent flowers. Also remove seed pods, as these tend to sap a plant's strength. Exceptions are the flowering grasses and ornamental onions. Mid-season is a good time to apply a fertilizer, but this should never be regarded as a substitute for good soil preparation. Be aware of your plants' flower and foliage coloration. An off color may indicate a problem that can be corrected by fertilizing, watering or both.

To keep many perennials from flopping over, staking is often necessary. Natural materials, such as branches or twigs, are the most readily available. An excellent source is privet, as it grows straight and branches at the right point. Tall, erect-growing plants, such as foxglove, dahlia and delphinium, can be supported by bamboo stakes. Wire supports are also effective and almost impossible to detect.

Mulching

Summer mulching helps control weeds and retain moisture. Mulch must be chosen carefully to be esthetically pleasing. Shredded leaf mulch and finely ground bark are excellent.

Photo by Roche

The dappled sunlight of a wooded area highlights the pale-blue-to-lilac hues of Phlox divaricata. *Its color is often variable.*

Bark materials will require additional nitrogen, as soil microbes will break down the bark — not a problem with leaf mulch. Other organic mulches include ground corncobs, rice hulls or ground peanut hulls. Local availability will likely influence your choice of material.

Dividing

To keep plants from outreaching their beds and to maintain a free-flowering condition, occasional dividing is in order. A few plants, i.e. peony, bleeding heart, gasplant, baptisia and balloon flower do not require dividing. Some, such as chrysanthemums, must be divided each spring. Others, such as heucheras, asters, phlox, helenium, shasta daisies, astilbe and physostegia, need dividing every three years. The rule of thumb is to perform the operation after plants flower. A knotted mat of leaf stems, dead woody centers and less-than-spectacular bloom are other indications that dividing is called for.

Fall Cleanup

Cut yellowing and fading stalks down to three to four inches. The resultant stubble provides anchorage for winter mulch. Mark late-appearing plants, such as balloon flower, with stakes. Mulch to prevent ground heaving caused by alternate freezing and thawing in winter. Wait until after the onset of a hard freeze. Care must be taken with plants that have evergreen tops. Too much mulch can cause them to rot. Such plants as Oriental euphorbia, poppy and anchusa (forget-me-not) need a light, airy mulch, such as evergreen boughs or pine needles and branches.

Annuals Are Reliable Standbys

BobbiJo Jarvis

No garden is complete without annuals. The most obvious reasons for their great popularity are that they add bold splashes of color, are inexpensive and are easily obtained. In recent years, plant breeders have improved many of our old favorites and garden standbys. For difficult situations, try new, improved varieties. From time to time, other plants may be more in vogue, but annuals will always enjoy a prominent place in the garden.

Many annuals perform well planted in containers. Nasturtiums provide color and texture while pinks bloom profusely.

Photos by George Taloumis

Geraniums are ever-ready sources of color. Breeders have improved these old favorites for better heat tolerance, earlier flowering and improved vigor.*

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**The common geranium (*Pelargonium *spp.), while grown as an annual in most parts of the U.S. and classified as such, will behave as a perennial (not needing to be replanted from year to year) in some tropical and semi-tropical climes.*

Plant	Plant height	Recommended varieties and/or comments
Achillea (yarrow)	8″	'Ballerina'
Ageratum houstonianum	6-8″	'Blue Tango,' 'Blue Danube'
Antirrhinum majus (snapdragon), dwarf	8″	Kolibri mix
A. majus (snapdragon), tall	30″	Rocket series
Artemisia (dusty-miller)	6-12″	Keep flowers pinched. Foliage.
Basil, 'Spicy Globe'	6-8″	Compact
Begonia semperflorens, bedding	8-12″	Shade. Many leaf and flower colors.
Begonia, tuberous	8-12″	Shade. Many leaf and flower colors.
Browallia	15″	Hanging baskets, borders
Cabbage, ornamental	8″	Cool seasons only
Calendula officinalis, dwarf	3-6″	
C. officinalis, tall	12-18″	
Catharanthus roseus (Madagascar periwinkle)	3″	Magic Carpet series (24″ spread)
Celosia cristata, spike	6-8″	Century mix. Warm colors.
C. c. plumosa, plume	8-12″	Century mix. Warm colors.
Centaurea cyanus (bachelor's-button)	12-36″	Great for naturalizing.
Coleus hybridus, dwarf	12-18″	'Fairway,' 'Midway,' 'Rainbow.' Lance-leaf.
C. hybridus, non-dwarf	12-30″	Must keep pinched.
Delphinium, giant	48″	Many colors. Stake.
Delphinium, dwarf	24″	
Dianthus chinensis & *D. c. heddewigii* (carnation, pink), dwarf	10-15″	Need support.
Gaillardia pulchella	12-24″	Warm colors
Gazania	6-12″	'Mini-Star Tangerine,' AAS winner.
Geranium, hybrid*	15″	'Smash Hit.' Bright Eyes series.
Geranium, basket	15″	Cascades.
Iberis (candytuft)	8-12″	Trailing plant

Small flat of hollyhock seedlings, started indoors in May, is ready for transplanting.

Photos by George Taloumis

Seedling Patio tomato, together with its peat-pot starter, can be set directly into the soil.

Containerized multiflora Petunia *'White Joy,' placed in the border or elsewhere, offers movable color.*

Plant	***Plant height***	***Recommended varieties and/or comments***
Impatiens wallerana (bedding plants)	12″	Can reach 30″ with good conditions. Accent series. 'Super Elfin,' 'Novette.'
Impatiens (New Guinea hybrid)	12-15″	Sun-tolerant
Lisianthus	12″	Needs support.
Lobularia maritima (sweet alyssum)	4″	White, rose or purple
Nasturtium	10-18″	Cascades.
Nicotiana alata (flowering tobacco)	12″	Nikki series
Papaver rhoeas (poppy)	12-15″	
Pepper, ornamental	4-8″	Inedible (very hot). 'Holiday Time,' 'Holiday Cheer.'
Petunia, grandiflora and multiflora	10-12″	'Picotee,' AAS winner. Cascade and double varieties.
Portulaca grandiflora (rose moss)	4″	'Sundance.' Uniform spreaders.
Rudbeckia spp. & cvs. (coneflower)	15″	'Goldilocks'
Salvia		Also purple varieties
Salvia, dwarf	8-12″	'Hotline'
Salvia, mid-tall	12-24″	'Carabiniere'
Tagetes spp. (African marigold), dwarf	6-8″	Inca series
Tagetes spp. (African marigold), tall	12-30″	
Tagetes (triploid marigold), dwarf (French)	8-10″	Golden series
Verbena hybrida, spreading	8″	
V. hybrida, upright	12-15″	Showtime mix. 'Trinidad,' an AAS winner.
Viola tricolor (pansy)	6-8″	
V. x *wittrockiana* (pansy)	4-6″	Some hybrids have extra-large flowers.
Zinnia, dwarf	6″	'Peter Pan' or Small World series
Zinnia, tall	12-36″	Sun hybrid series

**What have been commonly known by gardeners for years as annual bedding geraniums are actually species of the genus* Pelargonium. *True geraniums, perennials of the genus* Geranium*—because of their hardiness and attractive white-to-pink-to-blue flowers—have in recent years become increasingly popular choices for the perennial border. In this issue of PLANTS & GARDENS, the terms geranium and* Pelargonium *refer to the widely known, common geranium, while* Geranium *(in italics) indicates the perennials so classified botanically.*

VEGETABLES— ORNAMENTALLY SPEAKING

Steven A. Frowine

Gardening space is always precious, so it makes good sense, when choosing plants, to consider those that can perform multiple roles. For example, a wide variety of edible vegetables make very attractive ornamentals. Some are beautiful for the textures and varying shades of their green foliage alone, while others, such as flowering kale and cabbage and burgundy lettuce, are prized for the brilliant reds and purples of their leaves. Still more, such as tomato, pepper and eggplant, provide brightly colored fruits.

Most gardeners relegate their vegetables to an obscure area of the backyard, but there is no reason why they cannot be included in purely ornamental plantings. The interesting and abundant foliage of sweet potatoes, for instance, makes an excellent ground cover. And bush beans, cabbage, cantaloupe (especially the bush type, such as 'Musketeer'), cucumber (again, the bush form is best), eggplant, kale, rhubarb and okra are ideally suited for decorative borders. Vegetables can be planted both to contrast and complement

A hanging-basket planting of zucchini is not only decorative but makes the squash, in this case yellow, easy to see and harvest.

Photo by Elvin McDonald

Photo by George Taloumis

Raised border containing cucumber, passion vine, marigolds, dianthus, ageratum, snapdragons, cascading petunias, Kenilworth ivy, red cabbage, calendula and pink yarrow. Cucumbers and passion vine climb wire-mesh supports.

the bright colors of annuals. For example, a popular hot-weather combination is a row of peanuts with a backdrop of red salvia.

In addition to the usual, such as roses or grapes, other attractive climbers to consider for an arbor include scarlet runner bean, hops, standard cucumber varieties and bitter melon with its warty fruit.

Vegetables are also a welcome addition to the perennial border. Clumps of eggplants, various peppers, bush melons, determinant-growing tomatoes, such as the patio forms, and zucchini make striking contrasts planted among perennials.

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A variety of vegetables are eminently suitable for container planting. Lettuce, parsley and various small herbs work especially well as underplantings around small trees or shrubs in tubs. And ornamental peppers, eggplants and patio, 'Small Fry' or pixie-type tomatoes are good individual-container candidates. Melons and cucumbers can be grown in containers either in bush form or as vines trained on a lattice. Even bush forms of watermelon can be grown in containers. Some popular varieties include 'Sugar Bush' and 'Kengarden.' Vegetables also can be attractive hanging-basket plants. Special varieties of tomato, such as 'Florida Lanai,' 'Florida Petite' and 'Sweet 100,' are the best choices for this purpose. One cucumber variety, 'Pot Luck,' was developed especially for small containers and hanging baskets.

Growing vegetables as borders, in containers or with other ornamental plants does present certain challenges. The first question most people ask is, "What's my garden going to look like when I start harvesting the vegetables?" To offset this problem, some planning is in order. You can either start a new and different vegetable variety to replace the one you harvest, or plan to put in succession crops. Late lettuce started from seed in an out-of-the-way part of the garden can be transplanted into the display area when the earlier lettuce has been harvested. You can also interplant the beds with quick-growing annuals, such as marigolds (*Tagetes* spp. and hybrids), sweet alyssum (*Lobularia maritima*), edging lobelia (*Lobelia erinus*) and perennials that reseed themselves, such as Johnny jump-up (*Viola tricolor*). These plants will rapidly fill in the gaps left by harvested vegetables.

To reduce the hassle of frequent spraying of vegetables planted among other plants, it is always best to choose varieties that are disease-resistant. When plants have to be sprayed, use a solution that has the lowest toxicity possible. Many of the chemical sprays recommended for use on ornamental plants should *not* be used on edibles. To be on the safe side, always read the pesticide label. I have found that insecticidal soap, which is no more toxic than household soap, works well for controlling soft-bodied insects, such as aphids, spider mites, mealybugs and white flies.

Here are a few cultural pointers that may be helpful when you grow vegetables in containers by themselves or with ornamentals: Be sure to keep the soil moist and cool. You can do this by applying a two- to three-inch layer of an organic mulch, such as shredded bark, on the soil surface. If you have many containers, you might investigate the possibility of installing a drip irrigation system. Such a system makes watering much easier than drenching each pot by hand. You might find it helpful to mix a moisturizer, such as Terra-sorb, into the soil before planting. A material of this kind enables the soil to retain more water for longer periods.

Whether you have a compact urban garden or an extensive suburban spread, it is worth your time to think of ways to grow vegetables more creatively. Your efforts will result in a beautiful garden that pleases the palate as well as the eye.

Selected Vegetable Varieties with Special Ornamental Properties

Tomato plant growing in a hanging basket adorns a porch—attractive as well as practical.

CABBAGE

'Chieftain' and 'Ice Queen' are savoy types; they have crinkly leaves that provide interesting texture in the garden. 'Ice Queen' is a small-growing savoy type. 'Meteor' and 'Ruby Ball' hybrids are both attractive red cabbages.

CUCUMBER

The cucumbers most suited for ornamental gardens are the bush forms. Some of the varieties recommended include 'Spacemaster,' 'Bush Whopper,' 'Bush Champion,' 'Pot-Luck' (good for hanging baskets) and 'Patio Pik,' a dwarf-growing, pickling cucumber.

EGGPLANT

'Black Beauty,' 'Burpee Hybrid,' 'Blackbell' all have large, black fruits that provide beautiful contrast to red- or yellow-flowering annuals. 'Mordon Midget' is a dwarf form. 'Oriental Egg' has a small, white, egg-shaped fruit.

LETTUCE

'Buttercrunch' is a heat-resistant, compact-growing bibb lettuce. It adds a handsome, dark-green color to the garden. 'Ruby' and 'Red Salad' are both looseleaf forms, of bright-red color. 'Red Fire' is another looseleaf that's heat-resistant—a good one to try during the middle of the summer when most other lettuce varieties fail. 'Tom Thumb' is a dwarf bibb that's perfect for containers and small spaces.

MUSKMELON/CANTALOUPE

'Musketeer,' 'Bushwhopper' and 'Honeybush' are all compact, bush forms of cantaloupe.

OKRA

'Lee' is a dwarf form.

PEPPERS

Most peppers have ornamental fruits. "Sweet" types include bell, banana, pimento and cherry. Peppers in the "hot" category include cayenne, Hungarian, jalapeno, large cherry and Anaheim. One hybrid with brilliant-colored yellow fruit is 'Golden Bell Hybrid.' Park's 'Pot Pepper' is a dwarf form worth trying.

SWISS CHARD

'Rhubarb' chard has bright-red stems and attractive dark-green foliage.

TOMATO

Determinant-growing tomato plants will not grow beyond a certain compact size. They are usually best for ornamental plantings, since they won't require staking and do not become unruly in the garden. For containers and hanging plants, try the *very* compact varieties, such as 'Florida Lanai,' 'Florida Petite,' 'Florida Basket,' 'Tiny Tim,' 'Minibel' and 'Smallfry.' The patio-type tomato is also a determinant grower that matures at about two to two-and-one-half feet. This is a good size for use in a perennial garden. Some of the popular varieties include 'Patio Prize,' 'Better Bush,' 'Stakeless,' 'Basket King' and 'Pixie Hybrid.'

WATERMELON

As with cantaloupe, it is best to use the bush forms. These plants grow no larger than three to five feet across. Some of the better varieties include 'Sugar Baby,' 'Kengarden' and 'Bushbaby.'

Herbs in strawberry planter placed close to the kitchen door allows for handy culinary snipping.

Photos by Elvin McDonald

Ten Perennial Questions about Herbaceous Perennials

Ray R. Rothenberger

After nearly 20 years of answering questions about growing herbaceous perennials, I find that the problems gardeners face in this area of horticulture are more perennial than the perennials themselves. Many questions come from new gardeners as they discover the pains or pleasures of growing herbaceous perennials for the first time. But even experienced gardeners find challenges they never faced in all their experience, and numerous, diverse questions arise.

Here are ten that cover the herbaceous perennials I am most often asked about. I have worded these queries in such a way that they may be applied to a variety of plants. Some readers might regard it more useful to be specific, but I have opted for a general approach that I trust will instill a broad understanding of the way perennials grow.

1 *When is the best time to plant (or transplant)_____?*

It would seem that such a question might be reserved for unusual plants, but most often I have found it asked about the old standards, such as iris, peony, daylily or Oriental poppy. As a general rule, the best time to plant or transplant is when the subject is in a dormant or semi-dormant condition. This may be either in late summer and fall, or in late winter, just before growth begins. Some favorites that flower early in spring, such as iris and peony, are best divided and transplanted in late summer. Iris normally have slowed growth in August, but need time to re-establish before winter. Transplanting in July or August allows enough time for establishment and development before early spring flowering. Oriental poppies need dividing in total dormancy, after the foliage dies in late spring, but before new foliage begins to grow in late summer. It's best to plant or transplant any perennials with marginal hardiness in spring, rather than fall. In the end, the most precise answer to this question is determined by local climate conditions and the cultural needs of the perennial in question.

2 *Why doesn't my_____bloom?*

This is a difficult one because there are a number of factors that contribute to failure of flowering. A frequent recommendation is "add some phosphorus" (or a phosphorus source, such as bone meal). However, lack of flowering is more often related to improper location or pests. Too much shade, poor drainage, insects and disease are common causes. Low fertility and too much shade are frequent contributors to poor flowering in

Ray R. Rothenberger, Professor of Horticulture and Department Chairman, University of Missouri, writes weekly gardening columns and hosts radio programs.

peonies, while in iris, the iris borer may weaken plants grown in some areas. Thrips can seriously damage the flower buds of daylilies. Bulb plants, such as daffodils, may become too crowded after several years, so clumps fail to flower, or flowering is greatly reduced. Poorly adapted plants, such as delphiniums growing in the hot Midwest, flower poorly or not at all, while some with marginal hardiness, such as tritoma, may survive the winter but be weakened too much to flower. When in doubt, consider the following: (1) Check carefully for pests or diseases; (2) consider moving plants to a new location with improved soil conditions, or (3) if a hardiness problem, provide winter protection. Again, know your plants.

3 *What are the best perennials for a _____ location?*

Insert hot, dry, shady, moist or a combination of these or others in the blank above. For a variety of conditions, the old standards, including iris, daylily, peony, phlox and chrysanthemum, are good choices but they are not the answers for a shady, moist site. Here we might consider hosta, astilbe and cardinal flower.

A border between a brick path and wall is fronted with ivy followed by boxwood and finally a beautful backdrop of coral bells.

Other considerations for answering this question are: "How much time and interest are you the gardener willing to provide? Can drainage be improved? Can irrigation be provided? Can other plants be removed or branches cut back to improve light penetration?" If your microclimate can be manipulated, your choice of plants becomes considerably widened. Another factor relates to a gradual change in the amount of sun or moisture that plants receive. For example, as nearby trees become larger, the microclimate changes and plants that were perfectly healthy and flowering well for years may begin to weaken or die. Replacing these with plants of the same type will inevitably be disappointing. New species better adapted to the changed environment must be selected.

Feathery blooms of astilbe mark the foreground of this view of a mixed perennial border. The interplay of colors, textures and leaf and plant shapes works its magic to breathtaking effect.

Photo by Roche

4 *How often do I need to transplant my _____? (You name it.)*

Although this may not seem very scientific, the best answer is: whenever a plant begins to decline in growth, flowering or both. Cultural decline should not be confused with damage from pests or a year of unusually bad weather. If all conditions are optimum but plants gradually produce fewer flowers or less foliage, lifting and dividing may be the best approach to improving vigor. In most cases, reduced vigor is a response to crowding. As a plant enlarges, central portions cannot compete with outer portions; there is inadequate moisture and fertility to sustain the dense clump of stems and roots. Here the amount of attention paid by the gardener may also be in question. Proper fertilization and regular watering can reduce the need for frequent dividing. At the other end, poor growth resulting from low fertility or lack of water can also reduce transplanting frequency, but it reduces the satisfaction derived from the plant, as well. Disease, another frequent problem, may build up in one area, calling for division and moving plants to a clean location. If the disease is serious and pervasive, it may be best to discard the plants, and purchase new ones for planting into a new area.

5 *Why did my _____ change to one color although I planted many colors several years ago?*

Most often the answer may be explained by competition among several varieties of plants. What happens is that one variety crowds out others. Sometimes there is a difference in disease susceptibility, and one or more varieties is infected and dies out while another is especially resistant and survives. The idea that varieties easily revert to other colors is, for the most part, false. While mutations are not impossible, it is unlikely that a mass planting would develop in this way. In some cases, plants of one particular color may produce more abundant seeds than the others. As the seedlings develop, they gradually crowd out the remaining original varieties.

6 *What is the best fertilizer for perennials, and when should it be applied?*

As a general rule, plan to fertilize in spring

Photo by George Taloumis

When plants are chosen wisely—in this case hostas, fuchsias, coleus, hydrangea, rhododendron and tuberous begonias—little in interesting texture and color is lost to the limitations of shade.

and repeat later in the summer, about August, if necessary. Whether the second application is needed depends on the vigor of the plants. In very sandy soils, which do not hold fertility well, even a third may be necessary. Since most perennials are grown for their flowers, a high phosphorus fertilizer, as mentioned earlier, should be used. Remember that the middle number of the three-number sequence of a fertilizer refers to the percentage of phosphorus. A very common, and good, fertilizer for perennials is 5-10-5 which is best applied at a rate of two to three pounds per 100 square feet of bed area.

7 *Can I (and if I can, how do I) grow _____ from seeds?*

This question most often arises in response to finding seeds originating from a particular perennial in the garden. Having a smattering of knowledge about plant breeding, gardeners have hopes of developing a desirable new form or color.

In the case of perennials, I do not encourage saving seeds and growing your own. Some, such as ox-eye daisy, are so prolific that the question becomes irrelevant. Others, such as peony, may be tempting to grow from seed but the results will be disappointing. The varieties we purchase are more

often than not the results of carefully made crosses. They have been reproduced asexually, and seeds from these plants may result in any form imaginable, usually poorer than the parent. For those who have plenty of time and space, growing from seed can be interesting, and occasionally rewarding. But for the average gardener, it is more likely a waste of time.

This does not answer the question, "How do I grow from seed?" Many seeds will germinate soon after harvest. But others, such as perennials from temperate climates, require a dormant period during which the seeds must be chilled before they will germinate properly. This often requires fall seeding, either in a cold frame or a protected spot outdoors, or if planting in a pot, chilling in the refrigerator or other cold, non-freezing spot for several months.

Perennials that germinate without chilling may be sown in a greenhouse in February or March. These will sometimes flower in the same year. However, most will not flower until the second year. The best months to sow perennial seeds outdoors are May and June. Conditions are still good for germination, and plants will grow and develop enough during the summer to allow for flowering the next year. The seedbed should be in a lightly shaded area protected from heavy rains or strong winds. A cold frame is ideal.

8 How can I keep my _____ from being killed this winter?

Here the questioner is most often asking about chrysanthemums in our climate (Missouri), but the blank may be filled in with any slightly tender perennial in a wide range of localities. The solution, most often, is to use a mulch. In the case of perennials that develop fall growth, such as chrysanthemums, Oriental poppies, daisies or others, the mulch should be loose to provide some light and air penetration, but dense enough to reduce drying winds and extreme temperature fluctuation. Loose leaves and straw will protect the crowns, while bark or sawdust may be used on the soil between plants, but not over the crowns. Evergreen branches from junipers or pines that need pruning can be a readily available, no-expense winter

A body of water can moderate climate extremes and make possible the growing of some perennials that would not survive in the same locale without it.

Photos by Roche

cover for many plants. In colder climates, the protection of a well sealed cold frame may be the best solution. Some plants, such as chrysanthemums, must be lifted in fall and moved into special structures for overwintering. Snow, by itself, can be a good mulch, in fact, the best if your climate provides a persistent cover all winter.

If you have chosen to challenge nature by using plants that are not suited to your winter conditions, you are gambling. If a severe winter develops, no mulch or other protection short of a greenhouse can insure survival.

9 *Why did my _____ die?*

Although I list this question ninth, perhaps I should list it first because it certainly is a common one. I hide it here because it is very difficult to answer without some knowledge of each situation. Most often the causes of death are poor adaptation — either winters are too cold, or summers too hot and dry. Soil adaptation is also a problem for some plants that require excellent drainage, but are planted in compacted, heavy clay soils, or where water cannot move away from the crowns during winter or a cold spring. While poor winter adaptation may result in abrupt death, poor drainage often results in slow death, usually in conjunction with crown rot that develops at or below the ground line, killing roots or lower stems. There are no chemicals that can control crown rot with any durability or regularity. The best solution for such poor drainage problems is a raised bed, or some similar method of alleviating the condition. Another approach is to move these plants to a new location and replace them with varieties that can tolerate the lack of drainage.

Also responsible for plant death are insect pests. They are usually evident, and the observant gardener can see such small ones as spider mites with the aid of a magnifying glass.

In the case of newly planted perennials, death may result from other reasons, such as planting too deeply. Perennials may settle. If set in the ground even slightly deeper than the ideal level, they may dig in even more and suffocate. Never plant deeper than the plants have been growing. When in doubt, plant at a shallow depth, making sure all roots are completely covered. With some perennials, such as peonies, planting too deeply will often allow the plants to grow well, but flowering will be inhibited.

Annuals add color and variety to the perennial border. Here alyssum, an annual, alternates with artemisia and reflects its inclination to cascade.

10 *Can I develop a continuing sequence of bloom with perennials that are easy to grow, or do I need many types? Can I have flowers in my perennial border for 12 months of the year?*

The answers to these questions depend very much on where the gardener lives. In our part of the Midwest (Missouri), we cannot expect flowers in the garden for 12 months of the year. It simply gets too cold for this to happen. I have had some species of crocus flowering in late January in mild winters, but this is not dependable. Fall crocus can carry into October, and mums will fill out November, perhaps flowering into December if it is mild enough. But this is not what I would call 12 months of reliable flowering.

A continuous series of bloom for the warmest parts of the year is possible, particularly when spring-flowering bulbs are added to a base of the old standards which, in order of flowering, include iris, peony, daylily, phlox and chrysanthemum. These five alone could carry color from early spring to late fall, but combined with the many others available, a sequence of easy or difficult plants is possible. This is one of the most interesting gardening puzzles to solve, and whether or not you ever do, you will always be rewarded by the ever-changing picture you create.

Herbs as Bedding Plants

Cindy Gilberg

Many culinary and fragrant herbs are perennial plants, and like the more decorative among their relatives, have ornamental qualities. These assets earn for a variety of herbal plants a classification beyond the merely utilitarian.

Ever-smaller gardening spaces have led gardeners to begin combining plant groups into one integrated area. For example, flowering perennials can be interplanted in a vegetable garden. Or culinary and/or fragrant herbs with ornamental attributes can be attractive, as well as useful, planted in the flower garden. In the case of extremely limited garden space, herbs can be placed among both vegetable and flowering plants.

Planning a Garden

The first step in planning an herb garden is to become familiar with the plants. A visit to a public garden with an herb planting will be most helpful. In deciding whether or not to include a particular herb in your collection, consider these questions: Is the plant an

The cleverly rock-confined raised beds of this herb garden contain rosemary, rose geraniums, calendulas, artemisias, santolina, costmary, fennel, tarragon, marjoram, lavender, rue, oregano, salad burnet and savory.

Photo by George Taloumis

A less formal, "natural"-type garden mixes herbs with shrubs and sedums. *Photo by Roche*

annual, biennial or perennial? Is growth habit upright or prostrate? What are maximum height and width at maturity?

Herb gardens can be as small as a gathering of a few favorite and commonly used varieties or as extensive as an intricately designed bed of 400 square feet or more. In planning the garden, think first about how much time, energy and space your're willing to devote to it. Also keep in mind that a few plants go a long way. In most cases, it doesn't take more than a couple of leaves to flavor a favorite dish, especially when snipping fresh from the garden.

The beginning herb gardener may want to start small, perhaps with something as simple to design and work with as a "kitchen" garden. This is a compact planting of much-used herbs located near the kitchen door for the convenience of the cook. Once you have become well-versed with a small garden, you'll be more likely to feel confident enough to tackle a larger space.

Locate your herb garden in an area that receives at least five or more hours of direct sunlight. Plants grown in low light will become rangy and lacking in potency. A well-drained soil that is not too rich in humus is most desirable. Do not overfertilize (especially with nitrogen) or overwater your herbs, for this will also contribute to a reduction of flavor and fragrance.

Cultivation

Most herbs are highly tolerant of adverse conditions, making them easy to grow. In general, they require full sun and average-to-good soil with excellent drainage. Many will adapt to container growing. Most will not tolerate constantly wet soil or very rich soils. Of course, there are exceptions: Sweet woodruff and wild ginger prefer rich soil and a shaded location, and watercress needs to grow in water.

Propagate by seed, cutting or division. Sow seed in a shallow container of peat mixed with either perlite or sand. Keep warm and moist until the seedlings are well established. Transplant to the garden when danger of frost has passed. Some herbs, once established, are easier to propagate by cuttings or division. Take cuttings of stems that are neither too succulent nor too woody and treat as above.

Cindy and Doug Gilberg, graduates of the University of Missouri's School of Agriculture, own Gilberg Perennial Farms, which they established in 1979. They specialize in perennials, herbs and ground covers.

Herb gardens can be quite extensive, as is this formal, carefully manicured interpretation.

Photo by Barbara Lawton

Divide mature plant clumps in the spring or early fall.

Arranging Plant Material

Once a desirable location has been chosen, you are ready to select and arrange plant material in your design. Plan on paper, where mistakes can be erased! Trace out the area to scale and outline the bed. Determine the number of each plant group by marking out the area each will cover when mature. Plants do not grow well when overcrowded, yet you will want the ground covered.

Group the plants so that they will be easy to reach—stepping stones are helpful. Place the taller growing herbs in the back or middle of the garden with the shorter ones in front. Varieties of thyme, germander, santolina or chives can be used in combination to form a low perennial "hedge" around the edge of the garden. Parsleys (biennials) and the new basil 'Spicy Globe' (annual) are also useful along the periphery. Be aware of differences in foliage and color when combining plants. Sage, for instance, has coarse gray leaves, in contrast to the feathery-green foliage of dill or the smooth reddish leaves of 'Dark Opal' basil. Comfrey, costmary, horseradish and sorrel all have large straplike leaves. Use these as background for finer textured plants, such as lavender, rosemary and some of the scented geraniums.

If you use stepping stones, try planting the creeping thymes between each stone. They are small-leaved perennials, from two-to-four inches tall, that have blossoms of white, pink or red in late spring and summer. They can also serve as a ground cover among taller plants.

There are many herbs that complement vegetable plantings. Sweet basil and tomatoes go together as nicely in the garden as they do on the table. Dill and cucumbers, savory and beans—the list is a long one.

Use artemisias and mints with caution. For the most part, the artemisias are hardy perennials with beautiful silver foliage—commonly cut and dried for arrangements or wreaths—that are suitable as background plants. Artemisias grow very much like the mints, vigorously spreading by underground roots, with stems popping up everywhere. To restrict growth, one might plant artemisias and mints in a large container sunk into the ground. Another method is to place barriers, such as boards, bricks or stones, in the earth to inhibit underground growth.

Harvesting and Storing

Herbs may be cut at the end of the growing season and dried for winter use. Always pick unblemished, tender leaves. Wash them and then arrange on a screen or cheesecloth and place in a dry, shady location. If you prefer, branches may be hung upside-down in loose bundles in an area with good air circulation. When dry, place in clean jars with airtight lids. Never dry herbs in the sun or in a hot oven.

List of Selected Herbs

ANISE: Annual, 24″ tall, full sun. Mostly cultivated for seeds, although the leaves can also be used in cooking. Seeds have a licorice flavor; add them to baked goods, soups, beverages, sweet pickles, sachets and potpourris. Add chopped leaves to cream sauces, salads and boiled shellfish.

BASIL, SWEET: Annual, 12-24″ tall, full sun. Harvest before it flowers. Best known for use with tomatoes and as the main ingredient in pesto sauce, it is also used in salads, egg and cheese dishes, poultry and veal dishes—a versatile herb. Add 'Dark Opal' basil to vinegar for dressings.

BORAGE: Annual, 12-18″ tall, sun to partial shade. Spreads rapidly and likes a moist, well-aerated soil. Blue star flowers are edible and can be candied. Young leaves are excellent in salads, the taste suggestive of cucumbers. When cooked, taste is similar to spinach.

CARAWAY: Biennial, 8-12″ tall, growing to two feet the second year, full sun. Harvest seeds as soon as they ripen and darken. Roots of mature plants are a delicacy, prepared and eaten like carrots or parsnips. Add chopped leaves to soups and stews; add seeds to cookies, cakes, pastries and rye bread.

CATNIP: Perennial, 18-24″ tall, sun. Harvest as soon as plants are mature but before they start to yellow. Best known for its euphoric effect on cats.

CHAMOMILE, GERMAN: Annual, 12-24″ tall, full sun. Tea from dried flower heads is a soothing beverage. Excellent as a rinse for hair.

CHIVES: Perennial, 8-12″ tall, sun. Dig and divide clumps every two to three years. Is a mild substitute for onion.

DILL: Annual, 24-36″ tall, sun. Use seeds in pickling. Add finely chopped leaves to soups and salads, cottage cheese, eggs and sauces. Good with tomatoes.

FENNEL, SWEET: Annual, 48-60″ tall, full sun. Use leaves as a garnish and flavoring for salads, stews and vegetables. Boiled with salmon and mackerel, it lessens their oily quality.

Closeup of one of the beds pictured on p. 38 reveals a mixed planting of 'Dark Opal' basil, rosemary, santolina, thyme, calendula and rose geraniums. *Photo by George Taloumis*

HYSSOP: Perennial, 18-36″ tall, sun to partial shade. Oil derived from green portions of plant used in making perfumes. Excellent tasting tea made from green tops. Use in salads; adds a bitter, minty taste; also used in liqueurs.

LAVENDER: Perennial, 12-18″ tall, sun. Flowers in June and July. Cut blooms just before they open to retain highest aromatic properties. Valued for potpourris and sachets. The leaves are also very fragrant.

LEMON BALM: Perennial, 24-36″ tall, sun to partial shade. Prolific and easily grown, has bluish-white flowers May to October. Harvest before flowering for optimum fragrance, gathering both leaves and stems. Leaves impart a lemon-mint flavor to soups, stews, custards; also use in salad dressing and in iced tea and fruit drinks.

LOVAGE: Perennial, up to seven feet tall, partial shade. Divide plants every fourth year. Stalks and leaf stems are hollow and are used as a very aromatic celery substitute. Use in potato salads, soups and leafy salads. Use seeds in breads, herb butters. Leaves make a fragrant tea.

MINTS: Most mints are hardy perennials that will tolerate shade, up to two feet tall; among the most vigorous growing of herbs. The leaves are most commonly used in hot and iced teas and other drinks. Add dried leaves to potpourri.

OREGANO: Perennial, 18-24″ tall, full sun. Prune low after flowering to promote bushiness. Used widely as one of the main herbs in tomato sauces, beef and lamb dishes, in soups, salads and stews.

PARSLEY: Biennial, 12″ tall, sun to partial shade. Good all-round herb. Use on potatoes, fish, meats, eggs. Rich source of calcium, thiamin, riboflavin and niacin, and abounds in vitamins A and C.

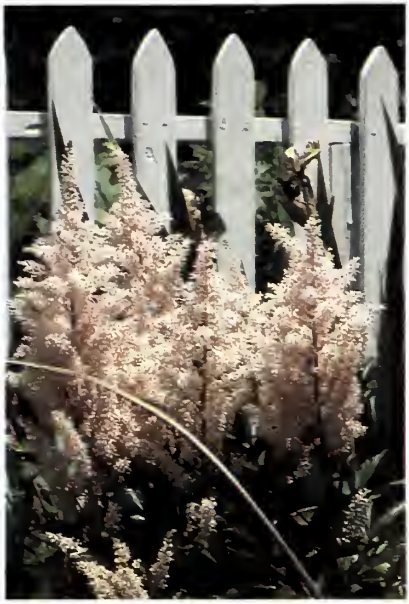
PINEAPPLE SAGE: Annual, 36-48″ tall, sun. Has red salvialike flowers and the leaves have a delightful smell of pineapple—a nice change for iced tea and other iced drinks.

ROSEMARY: Tender perennial, 24-48″ tall, sun. Useful in potpourri and sachets, also as seasoning for beef, veal, lamb, poultry, soups, stuffings, sauces and salad dressings.

RUE: Perennial, 24″ tall, sun. Known as the "herb of grace," it is a lovely bluish-green in

A section of Brooklyn Botanic Garden's own Herb Garden illustrates the ornamental effect created by intermixing tall- and low-growing specimens.

Fence, trellis and formal gardens—far-ranging bed-and-border options.



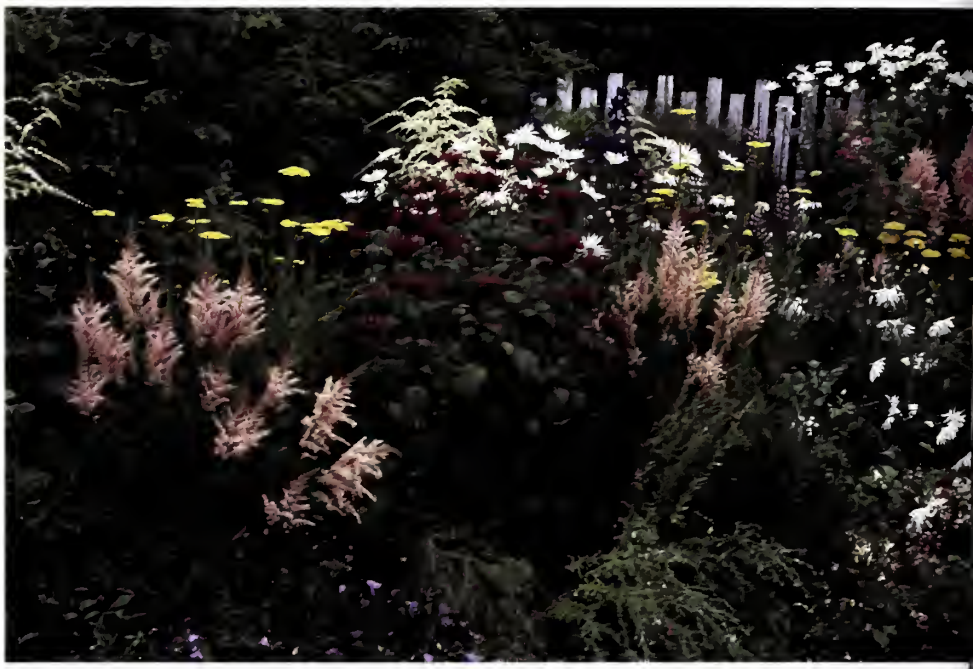
*Plumes of pink astilbe (*Astilbe *x* arendsii *'Rheinland') nicely contrast the white of a picket fence. Astilbes perform well in lightly shaded areas of the garden.*

A lattice-work arbor covered with wisteria provides a shady spot and framed view of colorful spring borders at Old Westbury Gardens.

The elaborate patterns of the parterre de broderie *(dating from 1657) at Vaux-le-Vicomte in Seine-et-Marne, France, were restored at the end of the nineteenth century. The Victorians revived the use of intricate bedding designs such as these and fortunately, though maintenance requirements remain enormous, many of their gardens survive to this day.*

Photos by Elvin McDonald

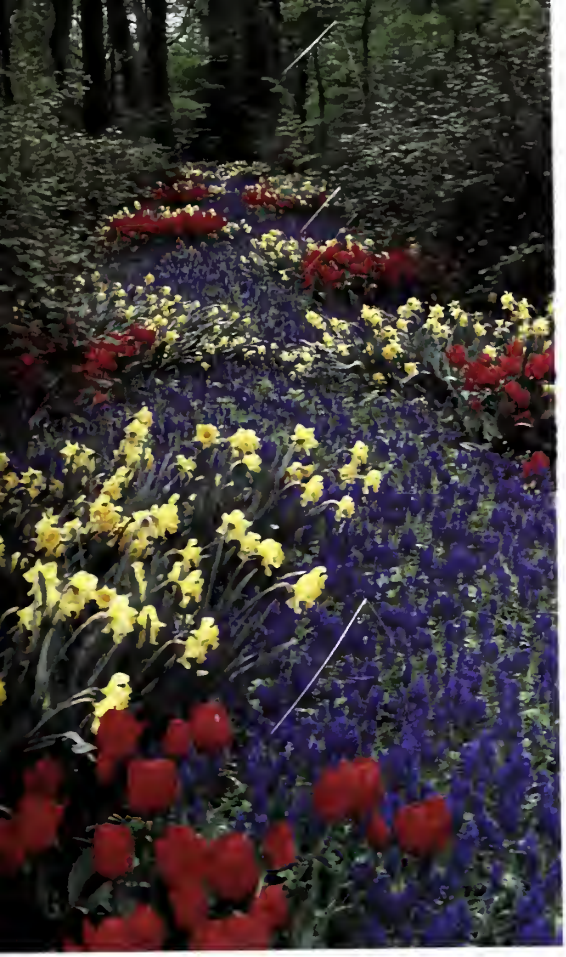
Color can be extended through the seasons.



A fence-backed border containing astilbes, monarda, achillea and Chrysanthemum *x* superbum.

Photo by Pamela Ha

Gardens planned with views from the inside of the house in mind expand and enhance interior spaces. Here a dogwood (Cornus florida) *and white azaleas frame the outdoor scene.*



Elvin McDonald

Woodland "stream" of red tulips, narcissus and grape hyacinths offers spectacular spring color at Keukenhof Gardens, Lisse, Holland.

A pool or pond adds another dimension to the garden. Siberian iris and water lilies, plants that thrive with water-soaked roots, are ideal for this setting. Peonies grow on the drier upper bank.

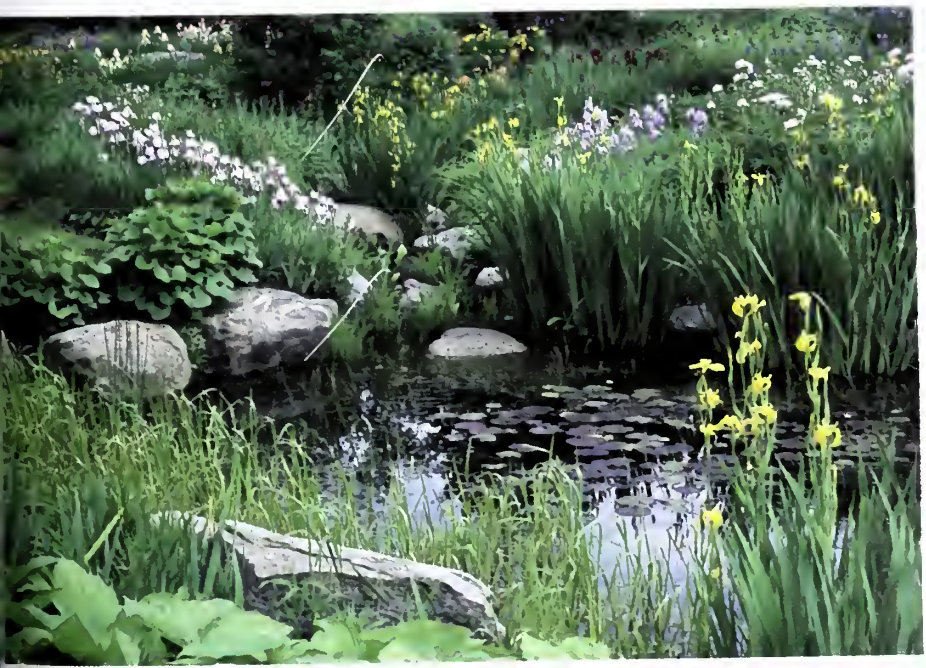
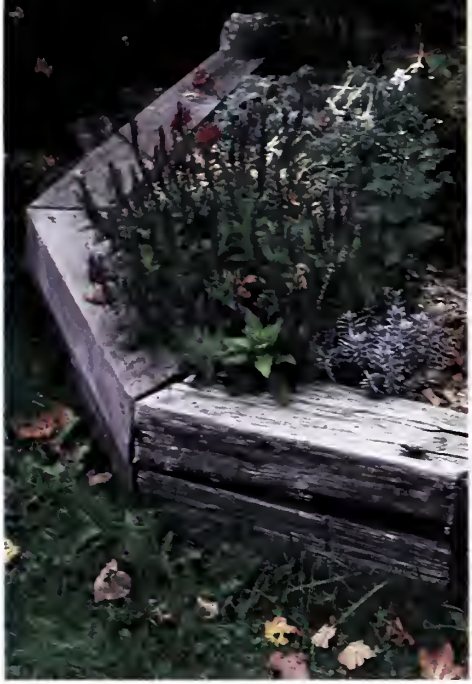


Photo by Elvin McDonald

Edgings frame and contain and provide contrasting textures.



Weathered railroad ties form a natural support and frame for a raised border containing Salvia *'East Friesland,'* Artemisia *'Silver Mound,' English lavender, geraniums, chrysanthemums and* Nicotiana *(flowering tobacco).*

Behind an edging of rocks and ferns, a border in Fred McGourty's Connecticut garden explodes with 'Enchantment' lilies, Heliopsis *'Golden Plume,'* Coreopsis verticillata *and* Asclepias tuberosa.

Steps show the way up a woodland slope with the showy sideline assistance of tulips, daffodils and arborescent Hedera helix *(English ivy in mature form).*

Photos by Elvin McDonald

color and is very aromatic. Not often used as a culinary herb, it is better known for its medicinal qualities.

SAGE: Perennial, 18″ tall, sun. Flowers are purple to blue and appear in August. Lots of parsley added to sage decreases its pungency. Add to poultry dishes and stuffing, liver, sausage, fish and cheese.

SALAD BURNET: Perennial, 12-24″ tall, sun. Can be used fresh or dry. Has a taste resembling cucumbers. Crimson flowers appear in June and July. Pick the leaves when young and tender and use in salads, sauces, soups, vinegars and as a garnish.

SANTOLINA: Perennial, 12-24″ tall, sun. Santolinas have pungent, silver-gray, fernlike foliage. Use leaves in sachets. Makes a good low hedge when clipped. Has a yellow, button-shaped flower in early summer.

SCENTED GERANIUMS: Not hardy in northern climes, but if planted in a sunny place, may grow to be quite bushy. There are several varieties, ranging in scent from peppermint to apricot to rose. They are widely used in perfumes, soaps and potpourris.

SUMMER SAVORY: Annual, 18″ tall, full sun. Likes a lot of water. Add to hot or cold bean dishes, meats, egg dishes, green salads, butter spreads and poultry stuffing.

SWEET MARJORAM: Annual, 12″ tall, full sun. Prefers rich, light soil. When the flowers appear, cut plant back to about an inch to stimulate new growth. Use with green vegetables, turkey, pork, lamb and eggs. Also nice addition to potpourris.

TARRAGON: Perennial, 24-36″ tall, sun. French tarragon cannot be grown from seed. Start from cuttings or divide. It is more valued than the Russian because it has a higher oil content. However, Russian tarragon is easier to obtain and can be substituted. Use it in seafood dishes, as it tends to lessen the "fishy" taste. Use it also in poultry dishes, leafy salads and most vegetables. Makes a flavorful cream sauce.

Photo by Elvon McDonald

A bed featuring herbs combined with other fragrant plants contains old roses, dill, pot-marigold and a santolina hedge.

WINTER SAVORY: Perennial, 10-12″ tall, sun. Seasoning use identical to summer savory.

WINTER THYME: Perennial, 12″ tall, full sun. Attracts bees when in bloom. Harvest just before flowers open; cut to two inches above the ground. After that, cut only the tips (upper one-third). Use in clam and fish chowders, stuffings for poultry and lamb, also in stews.

WORMWOOD: Perennial, 48″ tall, sun. Grows profusely and should not be placed near other plants, as it inhibits their growth. In a concentrated form, it is a volatile poison. A natural pest control, it will repel black flea beetles and moths. A weak tea bath will discourage slugs. Too bitter for culinary use, but is used to make vermouth and absinthe.

Sow Flowering Perennial Seeds in Fall

Ray R. Rothenberger

For the home gardener interested in growing flowering perennials from seeds, late summer and fall is a good time to get started. A cold frame outdoors is an ideal location, although seeds may be started indoors for fall planting into protected outdoor sites.

A carefully prepared bed in a sheltered site, such as close to a building, is also a good location for getting started. Most garden perennials require two or more years to produce their first flowers. The wait is usually well rewarded.

A simple cold frame is helpful and can easily be made from wood. Generally, cold frames are built about 18 inches high in back, 12 inches high in front, up to six feet wide and in any convenient length. Glass sash, or frames stretched with clear plastic, may be used to cover cold frames in late fall and winter. More detailed instructions for building cold frames are covered in the Guide Sheet 6965, "Building and Using Hotbeds and Cold Frames," available at the University of Missouri Extension Center.*

Common garden flowers that may be started from seed in late summer include Oriental poppy, painted daisy, gloriosa daisy, stokesia, columbine, delphinium, butterfly weed, baby's breath, hollyhock, pansy, viola and many others. Seedlings of these plants will grow amply in a protected location before winter weather arrives.

Perennials may be grown from seed in flats or pots in a cold frame or cool greenhouse.

Seeds can be started indoors for fall planting into protected outdoor sites.

Keeping seeds constantly moist with frequent light mistings will insure good germination.

Photos by Gottscho-Schleisner

Most perennial flower seeds germinate best when the soil is cool. Therefore, shade the cold frame from direct sun when seeds are planted. Burlap may be stretched over frames that may later be removed and replaced with clear plastic for winter protection. Lath strips or snow fencing also provide good shade. For starting only a few seeds, temperatures indoors are more uniform, and may be satisfactory. After germination has taken place, place pots outdoors in a lightly shaded spot to acclimate the seedlings to the outdoors.

Constant moisture is essential for good germination, especially in hot weather. In a cold frame, give frequent light mistings to keep the soil surface loose and lightly moist. If this cannot be done, cover the rows with cloth or paper until germination begins. Remove such coverings promptly, however, or the excess shade may weaken the seedlings and they will collapse when the covering is removed.

Indoors, slip the flat or pot into a plastic bag to keep the surface moist until seedlings appear. Outdoors, have a cover ready to place over the cold frame or seeded area to prevent severe summer rains from washing away the soil and seedlings.

A glass or plastic cover should not be placed on the cold frame permanently until late in the fall when there is no chance of warm weather. Ventilation will be necessary until the arrival of constant or severe cold. At that time, a straw mulch over plants in the garden or a covering over the cold frame for winter insulation will be beneficial. If straw is used, keep it loose, so as not to smother the seedlings.

If growing perennials from seeds is not for you, plants may be purchased, or those of friends easily divided. Oriental poppy, peony, iris, daylily, bleeding heart, phlox and baby's breath are a few that may be divided and replanted in late summer.

*Columbia, Missouri 65211

GARDENING IN CANADA IN THE OTTAWA VALLEY

Photo by George Taloumis

Columbine is a reliable bloomer in spring in Canada's Ottawa Valley. This one is a delicate pale yellow.

Anstace and Larry Esmonde-White gardened in many parts of the world before settling in Canada. They write gardening columns and host a PBS television series on gardening.

Anstace & Larry Esmonde-White

One of the facts of contemporary life is the necessity to move. Like us, many people find themselves being transferred to various parts of their own country and even to other countries and continents. We have lived in the United Kingdom, the Middle East, India and Canada. Our interests have always included gardening, and we have both learned the best ways to go about this rewarding pastime, wherever in the world we have found ourselves.

Our home now is in Canada, in the Ottawa Valley, about 20 miles from the St. Lawrence River and the border of upstate New York. Our winters are severe, but summers are hot, often humid, with long daylight hours.

We were both fortunate to have received our early horticultural training from our respective parents. As children we would accompany them on visits to friends' homes, where we would routinely tour the gardens and shrubberies. The adults would exchange information regarding newly acquired plants, and we would return home with cuttings, root divisions or seeds. These we would set out in outdoor propagation beds or in the greenhouse and we would follow our plantings' progress with childish wonder. All of the plants exchanged had already been proven suitable for the climate of our immediate area.

One aspect of gardening that was always heatedly discussed was soil. We both lived north of Dublin where the soil was neutral — neither acid nor alkaline. We couldn't grow acid-loving plants, such as azaleas and rhododendrons, although within just a few miles of our gardens, the soil conditions were so acidic that the mainstays there were acid-loving plants. It was through these childhood experiences that we learned of the need, wherever we ended up living, to visit local gardens before planning our own.

When we immigrated to Canada we were pleasantly surprised to find that it was possible to grow an extensive number of hardy perennials. In fact, to attain their full perfection, many of these require the long dormant period necessitated by this northern clime — delphiniums, for example. The tall bloom spikes, usually blue, make a striking accent at the back of a border. A second blooming in September is common if the plants are cut back after the first blooms fade.

Bearded iris (a dwarf variety here) also grow well in the Esmonde-White's northern garden. The blooms are good choices for color contrast in late spring and look best when massed, rather than scattered in a mixed border.

Our garden comes to life in late April with the appearance of spring-flowering bulbs and pansies. These are followed by peonies and bearded iris, *Geum,* cranesbill geraniums, *Euphorbia, Heuchera* and *Dianthus,* to name just a few.

Summer follows with a blaze of color — *Astilbe, Aquilegia,* shasta daisies, Oriental poppies, *Digitalis, Achillea, Anemone, Anchusa, Anthemis, Campanula, Gaillardia, Lythrum, Lychnis, Monarda,* meadowsweet, *Veronica, Phlox, Hemerocallis, Hosta* and many others.

Fall takes on the ruddy hues of rudbeckias, chrysanthemums and perennial asters. Michaelmas daisies, seen far too seldom, not only provide superb contrast to the strong colors of other perennials, but are also excellent for flower arrangements.

Our experience has been that, in determining what perennial plants we should acquire, zone maps can only be used as a rough guideline. The same can be said of descriptions in seed catalogs. Although *Kniphofia,* or red-hot-poker, for example, is listed as a hardy perennial, all of our attempts to grow it have failed. The only way it might survive in our general area would be in a warm, sheltered corner close to a building. On the other hand, we have had great success with lavender, and I'm sure this is due to our well-drained location and heavy winter snows.

Only through living and working with our garden have we learned the secrets of its microclimates. These distinct little pockets of weather are determined by buildings, trees, shrubs, bodies of water and prevailing winds. For instance, early in spring, deciduous trees to the south of our house allow the sun to penetrate and thaw the ground, providing good conditions for spring flowers. These same trees, after leafing out, shade the area, creating the perfect conditions for hostas and *Hemerocallis* (daylilies). The sheltered nature of this location keeps it frost free much longer into fall than some of the more open spaces, making it the ideal place for hardy, shade-loving plants.

Indoor work starts in early February and we don't venture outdoors until April. Gardening continues until the ground freezes and heavy snow drives us into the house, some time in November. Fall is as busy as spring; the work we do in September and October is the foundation for the following season. Spring changes to summer so rapidly that the perennial beds are best worked, enriched and the plants divided, where necessary, in the fall. A disruption of active growth in the spring would result in a decided setback.

Gardening in our area has proven to be a highly rewarding experience. Relying mainly on plants that have already been tested and proven suitable, we add new cultivars and try out one or two new species each year. This is a method of operation we would highly recommend to all fellow enthusiasts who garden in climates similar to ours.

Color Schemes

Doug Gilberg

How can color be used to make a perennial garden more beautiful? The following are four of the color schemes that have been employed successfully in some of the world's most renowned gardens:

The *monochromatic* garden utilizes flowers that are variations of one color. Foli-

The contrasts in color, texture and height between Phlox divaricata *and tulips are responsible for the success of this subtle design.*

A tapestry of assorted colors, textures and heights is a weave of Phlox subulata, Cerastium tomentosum, Iberis sempervirens *and broom.*

Photos by Roche

age textures and height differences, when combined, can create an intricate yet subtle design. A garden of this kind is useful for accenting the color of an architectural element in the landscape. For example, one might choose shades of either red or blue when planting against a white fence or wall.

A garden in which the flower colors are related to each other, such as yellow, yellow-orange and orange, is said to have an *analogons* color scheme. The analogous scheme can be very effective, even breathtaking.

A *complementary* color scheme uses colors that are opposites on the artist's color wheel. For example, yellow and violet are opposites, as are orange and blue. Complementary color schemes provide very strong combinations, and you may wish to add foliage plants or white flowers to temper the vibrancy. The grays and greens of the leaves of artemisia or santolina are good choices in this situation.

The most common color scheme, perhaps the easiest to work with, is the *polychromatic,* and this is the one that most of us gravitate to. In a garden with a variety of color, one's personal taste dictates the rules.

Discovery of the right plants for the right places in the proper proportions is an undertaking that cannot be rushed. In addition to color, height, texture and hardiness must all be considered. The quest for knowledge and the desire to experiment are traits of the experienced gardener, but perhaps the most important criterion for true artistry in garden design is that you enjoy all of the processes involved.

Cindy and Doug Gilberg, graduates of the University of Missouri's School of Agriculture, own Gilberg Perennial Farms, which they established in 1979. They specialize in perennials, herbs and ground covers.

Tree peonies lend luxuriant petal color and size to a mixed spring border of tulips and azaleas. Sunlight periodically breaks through the boughs of overhanging trees.

COLOR GUIDE

White

Achillea
Aconitum
Ajuga
Anacyclus
Anaphalis
Anemone
Antennaria
Anthemis
Aquilegia
Arabis
Arenaria
Armeria
Artemisia
Aruncus
Asperula
Aster
Astilbe
Aubrieta
Bocconia
Campanula
Carnation
Cerastium
Chrysanthemum
Cimicifuga
Clematis
Convallaria
Delphinium
Dianthus
Dicentra
Dictamnus
Digitalis
Erodium
Filipendula
Geranium
Gerbera
Gillenia
Gypsophila
Helianthemum
Helleborus
Heuchera
Hibiscus
Hollyhock
Hosta
Iberis
Iris
Lamium
Leontopodium
Liatris
Linum
Lobelia
Lupine
Lychnis
Lysimachia
Malva
Matricaria
Mazus
Monarda
Nepeta
Nierembergia
Ophiopogon
Penstemon
Phlox
Physostegia
Platycodon
Potentilla
Primula
Pyrethrum
Rudbeckia
Salvia
Saxifraga
Scabiosa
Sedum
Sidalcea
Silene
Statice
Stokesia
Thymus
Tradescantia
Verbascum
Veronica
Vinca
Viola
Yucca

Pink

Aconitum
Ajuga
Androsace
Anemone
Antennaria
Aquilegia
Arabis
Armeria
Aster
Astilbe
Bergenia
Carnation
Chrysanthemum
Delphinium
Dianthus
Dicentra
Dictamnus
Digitalis
Filipendula
Geranium
Gerbera
Gypsophila
Heather
Helianthemum
Helleborus
Hemerocallis
Heuchera
Heucherella
Hibiscus
Hollyhock
Iris
Lamium
Lavandula
Lupine
Lythrum
Malva
Monarda
Myosotis
Phlox
Physostegia
Platycodon
Polygonum
Poppy
Primula
Prunella
Pyrethrum
Rudbeckia
Saponaria
Sedum
Sidalcea
Thymus
Tradescantia
Tunica
Verbascum
Veronica
Viola

Purple and Lavender

Ajuga
Allium
Anemone
Aster
Aubrieta
Campanula
Centaurea
Delphinium
Digitalis
Echinops
Erigeron
Geranium
Heather
Hemerocallis
Hosta
Iris
Lavandula
Liatris
Liriope
Lythrum
Mazus
Monarda
Nepeta
Penstemon
Perovskia
Phlox
Prunella
Salvia
Sidalcea
Stachys
Statice
Thalictrum
Tradescantia
Veronica
Vinca
Viola

Blue

Aconitum
Adenophora
Agapanthus
Ajuga
Allium
Amsonia
Anchusa
Aquilegia
Aster
Baptisia
Campanula
Catananche
Centaurea
Clematis
Delphinium
Echinops
Epimedium
Erigeron
Eryngium
Eupatorium
Gentian
Geranium
Globularia
Iris
Linum
Lupine
Myosotis
Penstemon
Phlox
Platycodon
Plumbago
Polemonium
Primula
Pulmonaria
Salvia
Scabiosa
Stokesia
Tradescantia
Veronica
Vinca
Viola

Red

Acaena
Achillea
Anemone
Aquilegia
Arabis
Armeria
Aster
Astilbe
Aubrieta
Bergenia
Carnation
Dianthus
Digitalis
Epimedium
Fuchsia
Gaillardia
Geum
Helianthemum
Hemerocallis
Heuchera
Hibiscus
Hollyhock
Iris
Lathyrus
Lobelia
Lupine
Lychnis
Lythrum
Monarda
Penstemon
Phlox
Poppy
Potentilla
Primula
Prunella
Pyrethrum
Rudbeckia
Salvia
Sedum
Symphytum
Teucrium
Thymus
Tradescantia
Valeriana
Veronica
Vinca
Viola

Yellow

Achillea
Alchemilla
Alyssum
Anthemis
Aquilegia
Artemisia
Aster
Calceolaria
Carnation
Centaurea
Chrysogonum
Coreopsis
Digitalis
Doronicum
Draba
Epimedium
Euphorbia
Gaillardia
Geum
Helenium
Helianthemum
Helianthus
Heliopsis
Hemerocallis
Hollyhock
Hypericum
Inula
Lamium
Ligularia
Linum
Lotus
Lupine
Lysimachia
Oenothera
Opuntia
Potentilla
Primula
Pulmonaria
Rudbeckia
Santolina
Sedum
Senecio
Solidago
Tansy
Thalictrum
Thermopsis
Tritoma
Verbascum

**Color-Guide lists, plus those of following Height and Light Guides, courtesy of Garden Place (a by-mail source of perennials), 6780 Heisley Rd., P.O. Box 388, Mentor, OH 44061-0388.*

Height Guide

2-8 Inches

Acaena
Achillea
Aethionema
Ajuga
Alchemilla
Allium
Alyssum
Anacyclus
Anemone
Antennaria
Aquilegia
Arabis
Arenaria
Armeria
Artemisia
Aubrieta
Calceolaria
Campanula
Chrysogonum
Convallaria
Dianthus
Draba
Erodium
Euphorbia
Fuchsia
Gaillardia
Geranium
Geum
Globularia
Gypsophila
Heather
Helianthemum
Herb *Salvia*
Herniaria
Hypericum
Iberis
Lamium
Leontopodium
Linum
Lotus
Lychnis
Lysimachia
Mazus
Myosotis
Nierembergia
Penstemon
Phlox
Phlox subulata
Physalis
Polygonum
Potentilla
Primula
Prunella
Pyrethrum
Santolina
Saponaria
Satureja
Scabiosa
Sedum
Sempervivum
Senecio
Silene
Strawberry
Teucrium
Thymus
Tunica
Veronica
Vinca
Viola

9-18 Inches

Acanthus
Achillea
Aegopodium
Ajuga
Alchemilla
Allium
Anaphalis
Anchusa
Anemone
Antennaria
Anthemis
Aquilegia
Armeria
Arrhenatherum
Artemisia
Artemisia dracunculus
Aster
Bergenia
Campanula
Carnation
Carex
Catananche
Cerastium
Chrysanthemum
Coreopsis
Dianthus
Dicentra
Doronicum
Epimedium
Erigeron
Eryngium
Euphorbia
Festuca
Filipendula
Gentian
Geranium
Geum
Gypsophila
Heather
Helianthemum
Helleborus
Hemerocallis
Heuchera
Heucherella
Hosta
Iberis
Inula
Iris sibirica
Lamium
Lavandula
Linum
Liriope
Lychnis
Lysimachia
Lythrum
Mentha
Molinia
Nepeta
Oenothera
Opuntia
Origanum
Penstemon
Phalaris
Phlox
Phlox divaricata
Polemonium
Plumbago
Potentilla
Primula
Prunella
Pulmonaria
Pyrethrum
Ruta
Salvia
Santolina
Satureja
Saxifraga
Scabiosa
Sedum
Stachys
Statice
Stokesia
Symphytum
Tansy
Teucrium
Thymus
Tradescantia
Veronica
Vinca

In a formal garden in spring, an evergreen hedge nicely emphasizes alternate plantings of daffodils. When these finish blooming, perennials and annuals will take over.

Photo by Roche

9-36 Inches

Achillea
Aconitum
Adenophora
Anaphalis
Anemone
Anthemis
Aquilegia
Artemisia
Asclepias
Aster
Astilbe
Avena
Belamcanda
Bergenia
Campanula
Centaurea
Chrysanthemum
Coreopsis
Crocosmia
Delphinium
Dianthus
Dicentra
Dictamnus
Digitalis
Doronicum
Echinops
Elymus
Erigeron
Eryngium
Eupatorium
Filipendula
Fuchsia
Gaillardia
Gerbera
Geum
Gypsophila
Helenium
Heliopsis
Hemerocallis
Heuchera
Hosta
Hyssopus
Incarvillea
Inula
Iris kaempferi
Iris sibirica
Liatris
Ligularia
Lippia
Lupine
Lychnis
Lysimachia
Lythrum
Malva
Matricaria
Melissa
Mentha
Monarda
Oenothera
Ophiopogon
Penstemon
Phlox
Phlox suffruticosa
Physostegia
Platycodon
Poppy
Pyrethrum
Rosmarinus
Rudbeckia
Salvia
Sidalcea
Solidago
Symphytum
Thalictrum
Thermopsis
Tritoma
Trollius
Uniola
Valeriana
Verbascum
Veronica

Over 36 Inches

Aconitum
Amsonia
Anchusa
Artemisia
Aster
Baptisia
Bocconia
Boltonia
Centaurea
Clematis
Cortaderia
Delphinium
Digitalis
Erianthus
Filipendula
Gypsophila
Helenium
Helianthus
Hemerocallis
Hibiscus
Hollyhock
Iris sibirica
Iris spuria
Liatris
Ligularia
Lobelia
Miscanthus
Panicum
Pennisetum
Perovskia
Phlox
Salvia
Spartina
Veronica
Yucca

Light Guide

Shade (Full or Partial)

Acaena
Aconitum
Alchemilla
Amsonia
Aruncus
Asarum
Astilbe
Bergenia
Calceolaria
Cimicifuga
Convallaria
Epimedium
Erodium
Filipendula
Fuchsia
Gentian
Helleborus
Hypericum
Lobelia
Myosotis
Primula
Prunella
Pulmonaria
Teucrium
Vinca
Viola odorata

Sun or Light Shade

Aegopodium
Ajuga
Androsace
Anemone
Aquilegia
Arabis
Arenaria
Aster
Aubrieta
Baptisia
Chrysogonum
Clematis
Dicentra
Dictamnus
Digitalis
Doronicum
Erigeron
Eupatorium
Geranium
Geum
Gillenia
Heather
Heliopsis
Hemerocallis
Herb *Allium*
Heuchera
Heucherella
Hosta
Iberis
Lamium
Liatris
Liriope
Lysimachia
Lythrum
Malva
Mazus
Monarda
Nepeta
Nierembergia
Oenothera
Ophiopogon
Pachysandra
Phlox stolonifera
Phlox divaricata
Physostegia
Plumbago
Potentilla
Pyrethrum
Saponaria
Saxifraga
Sempervivum
Thalictrum
Tradescantia
Trollius
Veronica
Viola cornuta
Viola cucullata

Sun

Achillea
Adenophora
Agapanthus
Allium
Alyssum
Anacyclus
Anaphalis
Anchusa
Antennaria
Anthemis
Arenaria
Armeria
Arnica
Artemisia
Asclepias
Aster
Bocconia
Buphthalum
Campanula
Carnation
Catananche
Centaurea
Cerastium
Chrysanthemum
Chrysanthemum maximum
Coreopsis
Crocosmia
Delphinium
Dianthus
Draba
Duchesnea
Echinops
Eriophyllum
Eryngium
Euphorbia
Gaillardia
Geranium
Gerbera
Globularia
Grasses
Gypsophila
Helenium
Helianthemum
Helianthus
Herniaria
Hibiscus
Hollyhock
Inula
Iris kaempferi
Iris sibirica
Iris spuria
Lathyrus
Lavandula
Leontopodium
Ligularia
Linum
Lotus
Lupine
Lychnis
Matricaria
Opuntia
Pardanthus
Penstemon
Perovskia
Phlox decussata
Phlox suffruticosa
Phlox subulata
Physalis
Platycodon
Polemonium
Polygonum
Poppy
Ranunculus
Rudbeckia
Ruta
Salvia
Santolina
Scabiosa
Sedum
Senecio
Sidalcea
Silene
Solidago
Stachys
Statice
Stokesia
Symphytum
Teucrium
Thermopsis
Thymus
Tritoma
Tunica
Valeriana
Verbascum
Vinca
Yucca

EVERGREEN PERENNIALS

Acaena
Aethionema
Ajuga
Alchemilla
Arabis
Arenaria
Armeria
Aubrieta
Carex
Dianthus caesius
Festuca
Globularia
Heather
Helianthemum
Helleborus
Heuchera
Hyssop
Iberis
Linum narbonense
Liriope
Ophiopogon
Phlox stolonifera
Phlox subulata
Potentilla
Pyrethrum
Rosemary
Sedum acre
Sedum album
Sedum reflexum
'Oxbow Hybrid'
Sedum sexangulare
Sedum spurium
'Bronze Carpet'
Sedum spurium
'Dragon's Blood'
Sempervivum
Senecio
Teucrium
Thymus
Tunica
Veronica rupestris
Vinca
Yucca

Blue and white petunias poke through ivy vines in a raised-bed planting. Long after the petunias have gone, the evergreen ivy will ornament this format raised bed. A yew-hedge background helps rose blooms look their best.

Photo by Roche

Below is a list of perennials and their general blooming times. Choosing from each list will insure all-season bloom.*

Spring

(March, April, May)

Ajuga
Anemone pulsatilla
Aquilegia
Arabis
Arenaria
Armeria
Aster alpinus
Astilbe
Aubrieta
Aurinia saxatilis
Brunnera (Anchusa)
Bulbs
Dianthus
Dicentra
Doronicum
Galium
Heuchera
Iberis
Iris—bearded
Siberian
Japanese
Linum perenne
Mazus
Mertensia
Myosotis
Nepeta mussinii
Phlox subulata
Polemonium
Primula
Pulmonaria
Pyrethrum
Saponaria
Tradescantia
Trollius
Veronica
Viola

*Many of these plants will bloom again in the fall if the seed heads are cut back after the first bloom has passed.

Summer

(June, July, Aug.)

Achillea
Alcea
Anchusa
Anemone sylvestris
Anthemis
Aquilegia
Aruncus
Asclepias
Astilbe
Baptisia
Campanula
Catananche
Centaurea
Ceratostigma
Chrysanthemum—
Shasta daisy
Cimicifuga
Clematis
Coreopsis
Delphinium
Dianthus
Dicentra
Dictamnus
Digitalis
Echinacea
Echinops
Erigeron
Eryngium
Eupatorium
Filipendula
Gaillardia
Geranium
Geum
Gypsophila
Helianthemum
Hemerocallis
Heuchera
Hosta
Hypericum
Iris
Liatris
Lilium
Linum
Lynchnis
Lythrum
Malva
Matricaria
Monarda
Oenothera
Peony
Poppy
Penstemon
Perovskia
Phlox decussata
Physostegia
Platycodon
Potentilla
Rudbeckia
Salvia
Scabiosa
Thalictrum
Thermopsis
Tradescantia
Valeriana
Veronica

Fall

(Aug., Sept., Oct.)

Anemone japonica
Artemisia
Aster
Astilbe pumila
Campanula
Ceratostigma
Chrysanthemum
Cimicifuga
Clematis
Gaillardia
Helenium
Helianthus
Hemerocallis
Hibiscus
Hosta
Perovskia
Phlox
Physostegia
Salvia
Stokesia
Veronica

New Varieties on the Horizon

George B. Park and Roslyn Doss

Because of breeding work currently underway, there will be increased interest in the next few years in the following:

Ageratum—Varieties currently available shatter and set seed quickly. Working on kinds that resist shatter, thereby prolonging the bloom season.

Gazania—Working on separate colors, also varieties that open earlier in the day and close later.

Gerbera—compact varieties in separate colors.

Hibiscus—better plant habit. Will see dwarf, free-flowering varieties in separate colors.

Impatiens—Will see a broader color range of New Guinea impatiens available from seed. Also a better plant habit, earlier flowering and more fully *double* impatiens from seed.

Lisianthus—double-flowered varieties. Also better branching to give stockier plants.

Marigold—large-flowered, *dwarf* African types.

Portulaca—varieties that stay open for a longer part of the day.

Ranunculus—hybrids in a wide color range suitable for bedding-plant use.

Rudbeckia—presently, limited color range and poor plant habit. However, excellent dwarf doubles are now becoming available.

Shasta Daisy—traditionally late to bloom but working on early-flowering varieties.

Verbena—Sets seed and shatters all too quickly. Working on varieties that resist shattering, thereby increasing length of bloom season.

Vinca—Presently, very few colors available. However, working on broadening the range (including reds).

All-season color in the garden requires planning. Here tulip 'Princess Elizabeth,' a border of pansies and an azalea background were timed perfectly for simultaneous bloom in early spring. Peonies (between tulips and azalea), supplemented by annuals, will bloom later.

*Guide For Estimating Plants Per Square Feet**

Spacing	Plts./Sq. Ft.
4″	9.1
6″	4.0
8″	2.3
10″	1.4
12″	1.0
15″	.65
18″	.45
24″	.25

***For Example:**

If you have a bed that is 60 ft. long and 5 ft. wide (300 sq. ft.) and you want to plant on 15″ centers, multiply 300 × .65 = 195 plants.

Suggested
Bed and Border Plants for Specific Sites and Purposes

Barbara Perry Lawton

The following lists offer suggestions for planning garden beds and borders. If your climate tends toward extremes, you might check with local public gardens, garden centers and gardeners as to which plants are most reliable for your locale. Membership in the nearest garden club will give you access to solid plant and planning information for your area. Make notes, keep records and try a few new plants every year. These efforts will help make your garden match your ideal.

Lobularia maritima, *spilling onto a brick walkway, nicely softens its edges. This flowering creeper will not be daunted by placement in a shady location.*

Many sedums, especially the cultivars, have flowers that are excellent for drying. This one is 'Autumn Joy.'

Photo by George Taloumis

Ornamental grasses dry particularly well and are especially long lasting.

Photo by Gottscho-Schleisner

Flowers for Drying

Annuals

Blue salvia (*Salvia farinacea*)
Everlasting (*Helipterum roseum*)
Globe amaranth (*Gomphrena globosa*)
Ornamental grasses, annual
Statice (*Limonium bondnellii*)
Strawflower (*Helichrysum bracteatum*)

Perennials

Artemisia spp., some for flowers, some for silvery foliage
Baby's-breath, perennial (*Gypsophila paniculata* and var.)
Cupid's-dart (*Catananche caerulea*)
German statice (*Geniolimon tartaricum*), sold in most seed catalogs as *Statice tartarica.*
Ornamental grasses, perennial
Sea lavender (*Limonium latifolium*)
Sedum, some of the cultivars, such as 'Dragon's Blood'
Yarrow (*Achillea* spp.)
Yellow camomile (*Matricaria recutita*)

Petunias, low-maintenance annuals, offer dependable color, while fibrous begonias thrive in a shady-to-partly-shady border.

Low-Maintenance

Annuals

Cosmos (*Cosmos* spp. and var.)
Gloriosa daisy, Black-eyed Susan (*Rudbeckia hirta* var.)
Impatiens (*Impatiens* spp.)
Marigold (*Tagetes* spp. and var.)
Multiflora petunia (*Petunia hybrida* and var.)
Rose moss (*Portulaca grandiflora*)
Sage (*Salvia splendens*)

Perennials

The following do not require frequent dividing:
Butterfly weed (*Asclepias tuberosa*)
Globe thistle (*Echinops exaltatus*)
Japanese anemone (*Anemone x hybrida*)
Lily-of-the-valley (*Convallaria majalis*)
Oriental poppy (*Papaver orientale*)
Peony (*Paeonia lactiflora*)
Purple coneflower (*Echinacea purpurea*)
Stonecrop (*Sedum* spp.)
Thrift (*Armeria maritima*)

Another annual requiring minimum care is black-eyed Susan. Here its bright-yellow coloration is offset by white phlox.

Photo by George Taloumis

Astilbes are among the first-choice perennials for shady situations. A number of new varieties are now available.

Hot, Dry Areas

Annuals

Coreopsis (*Coreopsis tinctoria*)
Cornflower (*Centaurea cyanus*)
Morning glory (*Ipomoea purpurea*)
Ornamental grasses, annual
Rose moss (*Portulaca grandiflora*)
Snow-on-the-mountain (*Euphorbia marginata*)
Summer cypress (*Kochia scoparia*)
Sunflower (*Helianthus annuus*)
Zinnia (*Zinnia elegans*)

Perennials

Bearded iris (*Iris x germanica*)
Butterfly weed (*Asclepias tuberosa*)
Coreopsis (*Coreopsis grandiflora*)
Gaillardia (*Gaillardia aristata*)
Golden marguerite (*Anthemis tinctoria*)
Ornamental grasses, perennial
Sunflower (*Helianthus* spp.)
Yarrow (*Achillea* spp.)

Shady Borders

Annuals

Fibrous begonia (*Begonia semperflorens*)
Flowering tobacco (*Nicotiana* spp.)
Impatiens (*Impatiens wallerana*)
Lobelia (*Lobelia erinus*)
Monkey flower (*Mimulus* spp.)
Sweet alyssum (*Lobularia maritima*)

Perennials

Astilbe (*Astilbe* spp. and var.)
Cardinal flower (*Lobelia splendens*)
Forget-me-not (*Myosotis* spp. and var.)
Heartleaf bergenia (*Bergenia cordifolia*)
Lady's-mantle (*Alchemilla* spp.)
Lungwort (*Pulmonaria* spp.)
Monkshood (*Aconitum bicolor*)
Plaintain lily (*Hosta* spp. and var.)
Sweet violet (*Viola odorata*)

THE INFLUENCE OF CLIMATE ON PLANTS

Brian Ward

The term "hardiness zone" refers to a plant's ability to withstand cold and survive, and is of concern to all gardeners. There are ten such zones in the United States and Canada, and plants are assigned corresponding hardiness-zone numbers that range from one to ten.

My locale is Missouri, which can be described as a transitional state, as it experiences almost all of the vagaries of climate. The most important single factor affecting all local conditions is altitude; for every 250 feet above sea level, the temperature drops one degree Fahrenheit. Moderating influences include the presence of a large body of water (without the heat storage of the Great Lakes, the vineyard industry of northern Ohio and upper New York State would not flourish) and shelter from desiccating winter winds.

Many of the gardening books used in the United States are published in the United Kingdom and therefore contain information suited for the generally less extreme conditions of the English climate. Except for the Pacific Northwest, which has similar weather conditions, nearly all other regions require some translation if one is to use English gardening recommendations. A good exam-

Photo by George Taloumis

Large bodies of water retain seasonal cold and warmth, keeping the areas that surround them cooler in the spring and warmer into fall.

Here petunias, lilies and delphiniums create a riot of color.

Photo by Barbara Lawton

Old Westbury Gardens on New York's Long Island enjoys a climate moderated by the Atlantic Ocean and Long Island Sound.

ple is the orientation of the traditional perennial border. In England, the recommended exposure is toward the south but here in the Midwest, a northern orientation is advisable. The reason for this difference is the intensely hot summers.

When relocating to another part of the country, one often faces less than realistic expectations in establishing new gardens. Plants that were successful previously may produce sadly lacking results in a new locale.

A classic example is the southern *Magnolia grandiflora*. Although this tree grows successfully in most years in Missouri, recent bitterly cold temperatures and severe winds have resulted in browning of the leaves and extremely small flowers. These are in contrast to the majestic "dinner platters" that are the pride of most southern states.

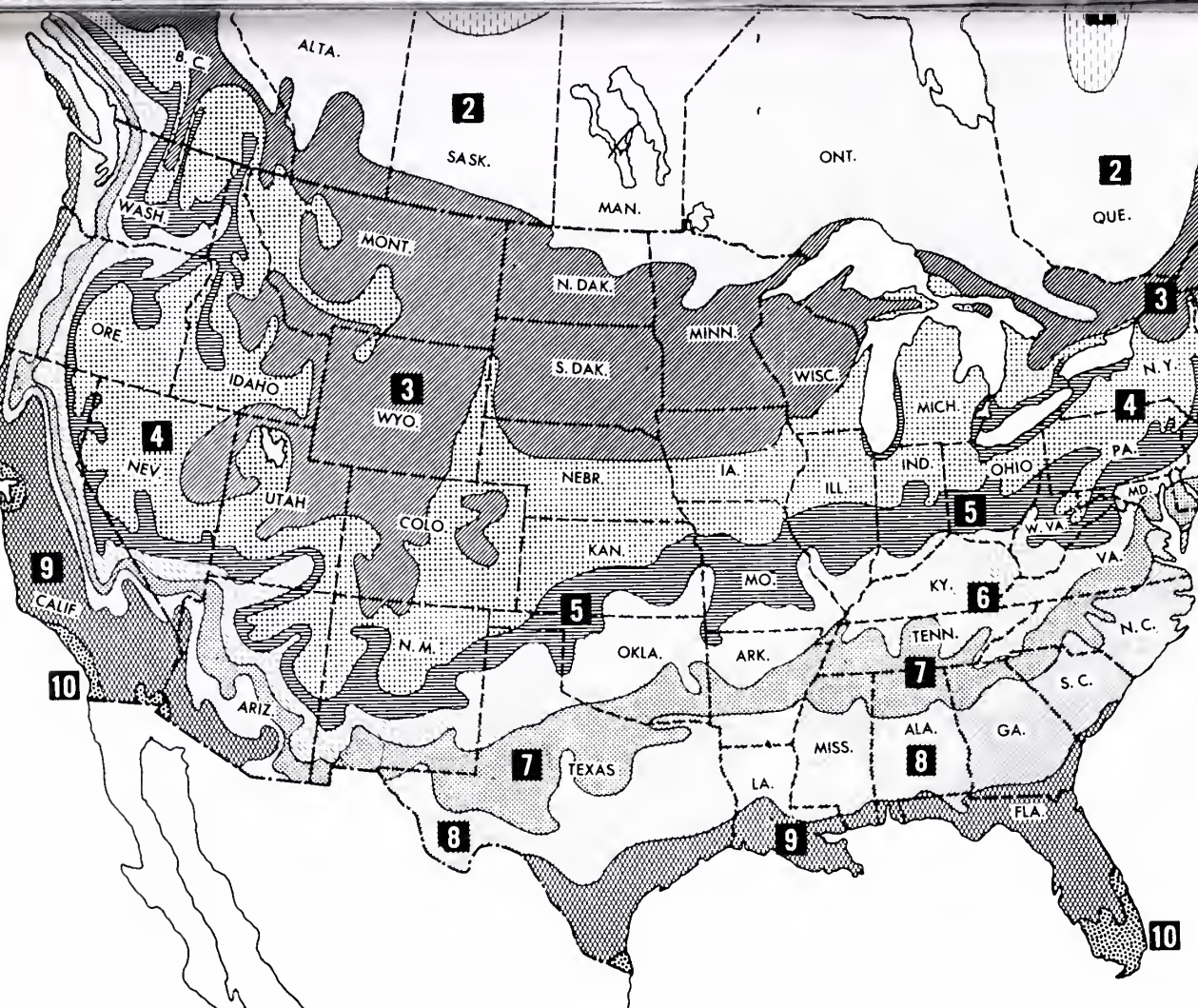
Interestingly enough, ten years ago or less, this desirable plant, native to such states as Louisiana and Mississippi, was growing and flowering very acceptably in the Midwest. Obviously we have experienced more damaging winters in the past few years.

If you wish to grow this handsome magnolia species, my advice is to espalier it against a west wall, which will help minimize desiccation of the leaves and facilitate covering the plant when the chill factor is especially severe. The magnolia's pattern of growth lends itself to espaliering. Another precaution against climate extremes is the use of a plastic spray (an antidesiccant) to reduce transpiration.

The influence of climatic conditions on the spectacular *Victoria amazonica*, the giant water-platter lily, is interesting. For instance, at the Royal Botanic Gardens at Kew in London where the summers are comparatively short and cool, these lilies can be raised successfully only in a heated pool in a tropical greenhouse.

At the Missouri Botanical Garden it is possible to grow them to maturity in an outdoor, unheated pool. To be sure, the seeds and seedlings must be overwintered in heated greenhouses. The more southern location of Hodges Gardens in Louisiana allows the lily seeds to be planted directly and germinated at the bottoms of outdoor pools. In the spring

Brian Ward, Staff Horticulturist, Missouri Botanical Garden, was trained at Kew in England and worked in Johannesburg, South Africa, before coming to this country.



HARDINESS ZONE MAP

The Limits of the Average Annual Minimum Temperatures for Each Zone

Zone 1.	Below	—50°	F.
Zone 2.	—50°	to —35°	
Zone 3.	—35°	to —20°	
Zone 4.	—20°	to —10°	
Zone 5.	—10°	to —5°	
Zone 6.	—5°	to 5°	
Zone 7.	5°	to 10°	
Zone 8.	10°	to 20°	
Zone 9.	20°	to 30°	
Zone 10.	30°	to 40°	

Compiled by The Arnold Arboretum, Harvard University

the seedlings are reset where they are needed.

The greatest influence on the weather along the west coast of the United Kingdom, stretching as far north as Northern Scotland, is the Gulf Stream, which originates near the continent of North America. This Atlantic-Ocean current moderates the hardiness zones of Britain.

Largely because of the Gulf Stream, some of Scotland's most beautiful gardens are located on the west coast. Here such exotic floral beauties as the Chilean fire bush (*Embothrium coccineum*), a member of the Protea Family, will thrive. Exotic plants imported into England during the Victorian period were, when first introduced, given stove-house conditions — hot and humid. This was tantamount to a death sentence for such spectacular species as the protea which must have both excellent air circulaton and drainage in order to flourish.

Obviously there was a breakdown in communication between botanists and horticulturists regarding plant requirements for these early introductions. An extreme example of plant hardiness is found in the rare *Protea cryophilia*, also known as the snow protea, which grows above the snow-line in the mountains of the Cape Province of South Africa. Attempts to relocate this plant to a lower elevation have so far been unsuccessful.

It is interesting to compare plant performance between Great Britain and the United States. For instance, the very beautiful rock-garden plant *Aubretia* is frequently recommended by English writers, but this early-flowering gem is not nearly as hardy in the mid-United States as it is in England. It often dies out after the second season, except in the Pacific Northwest, where it is the focal point of the spring garden.

Most of you are familiar with the floral displays of *Cornus florida* (dogwood). Its spectacular bloom epitomizes the arrival of spring in the South and along the Eastern seaboard of the United States. But when grown in England, the wood does not ripen enough for heavy flowering.

An interesting comparison between the Midwest and Britain can be made with regard to tree standards chosen for bedding-out schemes. In England two highly favored standards are fuchsia and heliotrope 'Cherry Pie.' They respond to the temperate summers with both beautiful flowers and bewitching scent.

By contrast, in the Midwest we use *Lantana camara* and *Hibiscus variegata* to give us that second or third level in bedding design. These respond so well to the hot summers that we must cut back and thin their growth.

Coleus varieties are not popular in England on a large scale for bedding purposes. Once again, we are looking at long hours of intense sunshine for satisfactory performance from these lovers of warm soil.

Special cultural recommendations are necessary to temper the extreme weather conditions of the Midwest and other areas. Whenever practical, raise annual and perennial beds six inches or more above ground. This has a number of advantages: The soil will drain more quickly, making it possible to work it much earlier in the spring. Annuals can then be planted sooner, allowing them to become established before the arrival of 95 to 100° temperatures.

During the winter, alternate freezing and thawing can cause major plant damage. Mulching will help overcome this problem and prevent the heaving of perennials, a condition that can cause plant death, especially in newly established borders.

The very handsome Asiatic *Magnolia soulangeana* is an exotic that cannot be depended upon in the St. Louis area. The solution for this precocious flowerer and other somewhat tender plants may be to choose a cool and shady location. Such a site may delay bud-break until the arrival of warmer, more settled weather.

Those of us in areas of extreme weather certainly must settle for second best where the tree-standard crape myrtles are concerned. Crape myrtles will grow in the Midwest, but only in bush form. They will flower in late summer and usually will die down to ground level over the winter.

Gardening is possible almost anywhere, but you must use plants that are tolerant of your climatic conditions and employ gardening techniques that will temper the effects of weather extremes.

Miscanthus sinensis *'Gracillimus' has showy inflorescences and is tall enough to provide screening.*

Elvin McDonald is a gardener, writer and Director of Special Projects at Brooklyn Botanic Garden. His twice-weekly column "Plants in the Home" is syndicated by King Features.

Ornamental Grasses

Elvin McDonald

Grass is so ubiquitous, most of us take it for granted. Gardeners in particular, accustomed to keeping undesirable grasses—either intruders from the lawn or out-and-out weedy types—out of flower borders, are understandably skeptical about introducing grass into beds of annuals and perennials. Despite this seemingly cautious or even negative view, the fact remains that there are among these cosmopolites extraordinary ornamentals: annuals, perennials, edgers, mid-border candidates, imposing backgrounders and screeners, colorful accents, showy inflorescences to enjoy fresh and dried, in the garden and out. Where the taller kinds are concerned, there is even the unexpected dividend of pleasant sound when breezes rustle the leaves.

Excepting the bamboos, only true grasses will be considered here. The clump-type bamboos, all tropical or subtropical, spread slowly and are easily kept in place. If you garden in the warmest parts of the United States Sun Belt, these are eminently worth introducing into beds and borders. Among the running kinds, many are cold-hardy but have a reputation for being too invasive to set free among other plants.

The least expensive way to get acquainted with ornamental grasses is to start with seeds, sold in mixtures of annuals or perennials. The annuals are meant to be rowed out in the cutting garden and harvested for bouquets. The perennials obtained this way need also to be started in a nursery row and, after a year or two, transplanted to permanent positions in the landscape as befits the size, color and habit of each.

Another possibility, if you have access to a meadow or other area where tufted or clump-forming grasses occur in nature, is to transplant the most attractive specimens to your garden. Spring is probably the best time, but with careful digging and an ample water supply, they move surprisingly well, even in full bloom.

Grasses in Brooklyn Botanic Garden's monocot border are, left to right, Miscanthus sinensis *'Zebrinus,'* M.s. *'Gracillimus' and very tall Ravenna grass (*Erianthus ravennae*), so-called hardy pampas.*

Photos by Elvin McDonald

Photos by Elvin McDonald

Some grasses such as this eulalia (Miscanthus sinensis *'Variegatus') have attractive variegated leaves that lend distinction to the border.*

If you would like to obtain a specific grass or set of grasses, and be able to identify each properly, then you will have to invest in seeds or established plants of individual kinds. The dozen or so most common are fairly widely available through seed and nursery catalogs and at local nurseries and garden centers. At the end of this article you will find a listing of catalog sources for every ornamental grass listed in the two charts devoted to annuals and perennials.

Assorted clump-forming grasslike plants, dug from the surrounding New England fields and potted, bring refreshing form to the deck of a weekend house.

Like most other plants, ornamental grasses are easy to grow if the most basic needs are met: spaded, friable, well-drained soil and ample moisture and light. Kinds suited to full sun, partial shade and shade are indicated in the accompanying charts. Insects and diseases are rarely a problem.

Apart from irrigation in times of drought, the only maintenance needed by the perennial grasses is to cut them to about six inches above the ground in late winter or early spring, before new shoots are actively pushing upward. Divide and replant as the center of the clump begins to die. For *Festuca ovina glauca,* this can be every couple of years, but most perennial grasses can go undisturbed for as long as a decade.

You might wish to provide your beds, borders or moveable containers with some of the plants that are attractively grasslike in habit, but not classified botanically as true grasses. If so, consider the following popular choices: sedge (*Carex*), flowering rush (*Butomus*), cat-tail (*Typha*), sweet flag (*Acorus*), any grassy-appearing iris, such as the Siberian, the lily-turfs (*Liriope* and *Ophiopogon),* gold-star-grass (*Hypoxis*), blue-eyed-grass (*Sisyrinchium*) and spider plant, especially the non-runner-forming *Chlorophytum bichetii,* but also any of the variegated forms of *C. comosum*.

Annual Grasses

Botanical Name	Common Name	Height	Flowering Period	Sources*
Agrostis nebulosa	Cloud grass	18″	4-10 wks.	2, 7
Avena sterilis	Animated oats	3′	4-6 wks.	5, 7
Briza maxima	Quaking grass	2′	6-10 wks.	2, 6, 7
Briza minor	Little quaking grass	9-12″	4-6 wks.	2, 4, 7
Bromus lanceolatus (B. macrostachys)	Brome grass	2′	6-10 wks.	2
Coix lacryma-jobi	Job's-tears	2-3′	10+ wks.	4, 6, 7
Eragrostis elegans	Love grass	18-24″	10+ wks.	4, 7
Hordeum jubatum	Squirreltail barley	18-24″	6 wks.	2, 7
Lagurus ovatus	Hare's-tail grass	12-18″	10+ wks.	2, 4, 6, 7
Lamarckia aurea	Golden top	1′	6-10 wks.	4
Leptochloa fascicularis	Spike grass	2½′	6-10 wks.	4
Panicum miliaceum (P. violaceum)	Panic grass	3′	6-10 wks.	7
Pennisetum setaceum (P. rueppeli)	Crimson fountain grass	4′	10+ wks.	1, 6
Pennisetum villosum (P. longistylum)	Feathertop	2′	6-10 wks.	7
Phalaris canariensis	Canary grass	2-4′	4-6 wks.	2, 7
Polypogon monspeliensis	Rabbit's-foot grass	18″	6-10 wks.	7
Rhynchelytrum repens (syn. Tricholaena roseum)	Ruby grass	1-2′	10+ wks.	4, 7
Setaria lutescens (S. glauca)	Glaucous bristle grass, yellow bristle grass	18-30″	10+ wks.	7
Setaria italica	Foxtail millet	2′	6-10 wks.	4
Triticum spelta (T. aestivum)	Spelt wheat	2′	4-6 wks.	2, 7
Triticum turgidum (T. durum)	Durum wheat	2′	4-6 wks.	2

*See p. 73 for key to source codes.

When it is well grown, pampas grass, a subtropical plant, makes a highly dramatic statement in the landscape.

Photo by George Taloumis

Perennial Grasses

USDA Hardiness Zone	Botanical Name	Common Name	Ht.	Form*	Uses*	Sources*
6-7	*Alopecurus lanatus*	Wooly foxtail	1′	T	S,RG	1
6-9	*Alopecurus pratensis* 'Aureus'	Yellow foxtail, meadow foxtail	1′	T-UO	S, G, M, RG	1
4-9	*Andropogon gerardii* (See Schizachyrium/ scoparium)	Big blue stem	4-6′	UA	S, G, M	1
4-9	*Anthoxanthum odoratum*	Sweet vernal grass	2′	UA-UN	S, DS	4
4-9	*Arrhenatherum elatius bulbosum* 'Variegatum'	Bulbous oat grass	1-2′	T-UO	S, PSh, M, RG	1
7-10	*Arundo donax*	Giant reed	9-12′	UA-UO	S, Sp, Sc, DF	1
8-10	*Arundo donax* 'Variegata'	Striped giant reed	5-7′	UA-UO	S, Sp, Sc	1
4-9	*Bouteloua curtipendula*	Side oats grama	2-3′	UA-UN	S, M	1
4-9	*Bouteloua gracilis*	Mosquito grass, blue grama	1-2′	T-UO	S, G, RG, N, DF	1
4-8	*Briza media*	Quaking grass	2-3′	UO	S, M, N, DF	1, 2
6-9	*Bromus ramosus*	Brome grass	3-4′	T	S, PSh, G	1
5-9	*Calamagrostis acutiflora stricta*	Feather reed grass	5-7′	UA-UN	S, G	1, 8
6-9	*Calamagrostis* x *arundinacea brachytricha*	Korean reed grass	2-3′	UA-UN	S, PSh, G	1
6-8	*Chaseolytrum subaristatum* (Syn. Briza subaristata)	Quaking grass	1′	UA-UN	S, RG	1
5-9	*Chasmanthium latifolium* (Syn. Uniola)	Northern sea oats	3-5′	UA-UN	Sh, G, M, N, FC	1
8-10	*Cortaderia richardii* (Syn C. conspicua)	Black pampas	5-10′	UN-UO	S, Sp, Sc, DF	1
8-10	*Cortaderia selloana*	Pampas	8-12′	UN-UO	S, Sp, Sc, DF	1, 4, 6, 8
8-10	*Cortaderia selloana* 'Argenteum'	Silvery blooming pampas	9-12′	UN-UO	S, Sp, DF, Sc	1
7-10	*Cortaderia selloana* 'Rendatleri'	Pink pampas	8-10′	UN-UO	S, Sp, DF, Sc	8
8-10	*Cortaderia selloana* 'Rosa Feder'	Pink pampas	9-12′	UN-UO	S, Sp, DF, Sc	1
8-10	*Cortaderia selloana* 'Sunningdale Silver'	Pampas	6-9′	UN-UO	S, Sp, Sc, DF	1
8-10	*Cortaderia selloana* 'Pumila'	Compact pampas	4-6′	UN-UO	S, Sp, DF	1
9-10	*Cymbopogon citratus*	Lemongrass	3-6′	I-UA	S, Sp, G	1
5-9	*Dactylis glomerata* 'Variegata'	Cock's-foot orchardgrass	1-2′	UO	S, PSh, G, E	1
4-9	*Deschampsia caespitosa*	Tufted hairgrass	2′	T-M	S, PSh, G, M, RG, N, DF	1
4-9	*Deschampsia caespitosa* 'Bronzeschleier'		3′	T-M	S, PSh, G, M	1
4-9	*Deschampsia caespitosa* 'Goldgehaenge'		3′	T-M	S, PSh, G, M	1
6-9	*Deschampsia caespitosa* 'Goldschleier'		2-3′	T-M	S, PSh, G, M	1
6-9	*Deschampsia caespitosa* 'Goldstaub'		2-3′	T-M	S, PSh, G, M	1
4-9	*Deschampsia caespitosa* 'Schottland'	Scottish tufted hairgrass	4-6′	T-M	S, PSh, G, M	1
4-9	*Deschampsia caespitosa* 'Tautraeger'		3′	T-M	S, PSh, G, M	1
4-9	*Deschampsia caespitosa tardiflora*	Late-blooming tufted hairgrass	3′	T-M	S, PSh, G, M	1
4-9	*Deschampsia flexuosa*	Crinkled hairgrass	2½′	T-UO	S, PSh, RG, DF	4

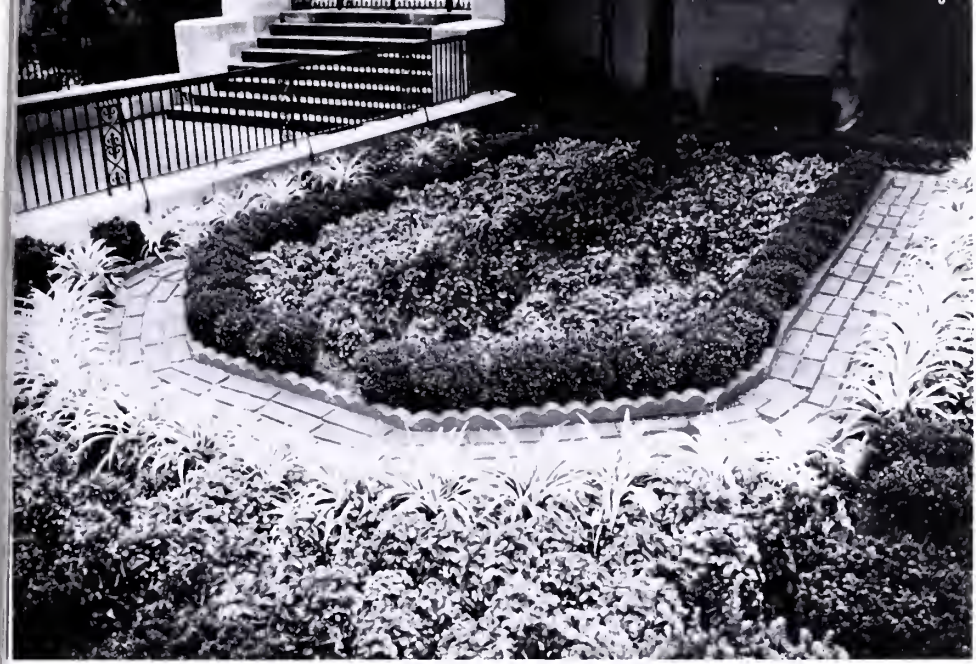


Photo by Elvin McDonald

Grasslike spider plant (Chlorophytum comosum) *forms a showy edging along the formal beds of this summer garden at St. Bartholomew's Episcopal Church in New York City.*

Perennial Grasses

USDA Hardiness Zone	Botanical Name	Common Name	Ht.	Form	Uses	Sources
5-9	*Deschampsia caespitosa viripara* 'Fairy's Joke'	Vivaparous hairgrass	3′	T	S, PSh, G, M	1
5-9	*Elymus* 'Vahl Glaucus' (Syn. Leymus racemosus)	Giant blue wild ryegrass	3-6′	UA	S, G, M	1
4-9	*Elymus glaucus*	Blue wild rye	2-4′	I	S, G, GC,	1
7-9	*Erianthus contortus*	Bent-awn plumegrass	5-6′	UC	S, PSh, MS	1
7-9	*Erianthus giganteus*	Sugarcane plumegrass	3-9′	UO	S, Sp, G,	1
6-9	*Erianthus ravennae*	Ravenna grass, hardy pampas	9-12′	UO	S, Sp, Sc, DF	1
7-9	*Erianthus strictus*	Narrow plumegrass	3-6′	T-UN	S, G, M,	1
4-8	*Festuca amethystina* 'April Gruen'	Olive-green sheep's fescue	8″	T	S, M, GC, RG	1, 3
4-8	*Festuca amethystina* 'Bronzeglanz'	Bronze sheep's fescue	8″	T	S, M, GC, RG	1, 3
4-9	*Festuca cinerea superba*	Blue fescue	6″	T	S, M, E	1
4-9	*Festuca ovina glauca*	Dwarf blue fescue	8-12″	T	S, M, E, RG, GC	4, 6, 7
5-8	*Glyceria maxima* 'Variegata'	Manna grass	2-3′	I	S, M	1
7-9	*Hakonechloa macra* (Syn. Phragmites macra)		2′	M	PSh, G, GC	
7-9	*Hakonechloa macra* 'Aureola'	Golden variegated hakonechloa	1-2′	M	PSh, G, M, GC	1, 3
4-8	*Helictotrichon semperrirens* (Syn. Avena)	Blue oatgrass	2′	T	S, G, M, RG	1
5-9	*Holcus lanatus*	Velvetgrass	1-3′	UA-UN	S, G	1

See p. 73 for keys to form, use and source codes.

Perennial Grasses

USDA Hardiness Zone	Botanical Name	Common Name	Ht.	Form	Uses	Sources
7-9	*Holcus lanatus* 'Variegatus'	Variegated velvetgrass	8″	T-OS	S, PSh, G, GC, RG	1
5-6	*Hystrix patula*	Bottlebrush grass	3′	UO	S, PSh, G, M, N, DF	1
7-9	*Imperata cylindrica rubra*	Japanese bloodgrass	1-2′	M-OS	S, PSh, G, M	1, 3
6-8	*Koeleria lobata* (Syn. K. brevis)	Blue hairgrass	4″	T-UN	S, RG	1
6-9	*Koeleria glauca*	Large blue hairgrass	1′	T-UO	S, G, M, RG	1, 4, 7
5-9	*Melica ciliata*	Hairy mellic pearlgrass	1-2′	T	S, PSh, G	1, 7
4-9	*Melica transsilvanica*	Transylvanian pearlgrass	1-2′	T	S, PSh, G,	4, 7
7-9	*Milium effusum*	Wood millet	2′	T	PSh, G, DF	1
7-9	*Milium effusum aureum*	Golden wood millet	2′	UO	PSh, G, DF	1, 7
6-9	*Miscanthus sinensis*	Eulalia	6-8′	UO	S, PSh, G, M, N, S, DF	1
6-9	*Miscanthus sinensis* 'Gracillimus'	Maiden grass	5-8′	UA	S, Sp, G, DF	1, 8
7-9	*Miscanthus sinensis purpurascens*		3-4′	Un-UO	S, Sp, G, DF	1, 8
6-9	*Miscanthus sinensis* 'Variegatus'	Variegated Japanese grass	5-7′	UO	S, PSh, S, G, MS, DF	1
6-9	*Miscanthus sinensis* 'Zebrinus'	Zebra grass	6-8′	UN-UO	S, Sp, G, MS, DF	1, 3, 8
4-9	*Molinia caerulea* 'Variegata'	Variegated purple moor grass	2′	T-UA	S, PSh, G, M, GC, RG	1, 3, 8
9-10	*Oplismenus hirtellus* 'Variegatus'	Ribbon grass	2-3′	OS	S, GC	5
5-9	*Panicum clandestinum*	Deer's-tongue grass	3-4′	UN	PSh, MS	1
5-9	*Panicum virgatum*	Switchgrass	5-8′	UN	S, G, M, Sc, FC, DF, N	1
5-9	*Panicum virgatum* 'Rotstrahlbusch'	Red switchgrass	3-4′	UN	S, MS, G,	1
5-9	*Panicum virgatum strictum*	Tall switchgrass	5-6′	UN-UA	S, MS, G	1
6-9	*Pennisetum alopecuroides*	Fountaingrass	3-4′	M	S, G, M, DF	1
7-9	*Pennisetum orientale*	Orient fountaingrass	2-3′	T	S, G, M	1
4-9	*Phalaris arundinacea picta* (Syn. P.a. variegata)	Ribbongrass, gardener's-garters	2-3′	UO	S, PSh, M, G	1
4-8	*Schizachyrium scoparium* (Syn. Andropogon scoparius)	Little blue stem	3′	UA-UN	S, G, M	1
6-9	*Sorghastrum nutans* (Syn. S. avenaeum)	Indian grass	4-6′	UO	S, G, M, N, FC, DF	1, 2, 4
5-9	*Spartina pectinata*	Prairie cordgrass	4-6′	UA-UO	S, MS, E, G, M, N	1
5-9	*Spartina pectinata* 'Aurea Variegata'	Variegated cordgrass	5-7′	UA-UO	S, MS, FC, G, M, DF	1, 3
7-10	*Stenotaphrum secundatum* 'Variegatum'	Striped St. Augustine grass	3-12″	OS	S, GC RG	5
6-9	*Stipa capillata*	Feathergrass	3-4′	UO	S, DS, G, DF	1, 6
7-9	*Stipa gigantea*	Giant feathergrass	4-6′	T	S, Sp, G	1, 8
7-9	*Stipa pennata*	European feathergrass	4-5′	UO	S, DS, G, DF	1, 4, 7
7-9	*Themeda triandra* 'Japonica'	Japanese themeda	4-5′	UN	S, Sp, G, FC	1

Photos by Elvin McDonald

The leaves of zebra grass (Miscanthus sinensis *'Zebrinus') make a pleasant sound when rustled by gentle breezes.*

Chart Codes

Form		Uses			
I	= Irregular	S	= Sun	E	= Edging
M	= Mound	PSh	= Partial shade	DS	= Dry soil
OS	= Open-spreading	Sh	= Shade	MS	= Moist soil
T	= Tufted	Sp	= Specimen	RG	= Rock garden
UA	= Upright-arching	G	= Groups	FC	= Fall color
UN	= Upright-narrow	M	= Massing	DF	= Decorative flowers
UO	= Upright-open	Sc	= Screen	N	= Naturalizing
		GC	= Ground cover		

Selected Sources for Ornamental Grasses

1) Kurt Bluemel, Inc., Nurseries, 2543 Hess Rd., Fallston, MD 21047;

2) The Country Garden, Rt. 2, Crivitz, WI 54114;

3) Endangered Species, Box 1830, Tustin, CA 92681-1830;

4) J.L. Hudson, Box 1058, Redwood City, CA 94064;

5) Logee's Greenhouses, 55 North St., Danielson, CT 06239;

6) Park Seed Co., Greenwood, SC 29647-0001;

7) Thompson and Morgan, Box 1308, Jackson, NJ 08527;

8) Wayside Gardens, Hodges, SC 29695-0001.

Several grass clumps create a pleasing background for a planting of celosia.

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Grounds, Roger. *Ornamental Grasses.* New York: Van Nostrand Reinhold, 1981.

Loewer, H. Peter. *Growing and Decorating with Grasses.* New York: Walker and Company, 1977.

Meyer, Mary Hockenberry. *Ornamental Grasses.* New York: Charles Scribner's Sons, 1975.

GARDENING IN THE SHADE

Photo by Roche

Borders of Aurinia saxatilis, *candytuft and* Spiraea prunifolia *along a front walk lend a feeling of welcome to a shady entranceway.*

BobbiJo Jarvis

If you've ever fought to grow lawn grass or other plantings on the north side of your house or under a large shade tree and lost the battle, try a fresh approach with something other than lawn, impatiens or begonias. There are a variety of vines, shrubs and trees that can add texture, greenery and even color to a shady site.

An increasing number of perennials and woody plants are being cultivated and gaining wider distribution today as more gardeners require plants for difficult situations. In a shaded garden spot, it's advisable to experiment with variations in texture and color, including shades of green.

Many shade-loving plants are more precisely shade-tolerant. While they will perform acceptably in shady locations, they also grow, sometimes thrive, in higher-light intensities. Flowering plants are prime examples; lush foliage and continuing growth occur in shaded conditions, but flower production increases with light.

Most gardeners have varying degrees of shade in their garden. If shade is created by a building or tree, sun may be available part of the day, providing a good location for flowering plants. Deeper shade sites lend themselves to plantings of ferns, hellebores and trilliums.

Try some of the following plants in your shady garden or in containers, to add interest to a shady patio or terrace.

Japanese primroses, left, planted among ferns, lay a luxurious carpet of bloom in a densely shaded woodland setting.

Perennials

Botanical Name	**Common Name**	**Shade Tolerance**
Astilbe spp. & cvs.	False spire	light—deep
Bergenia spp.	Bergenia	light
Caladium	Caladium	light—deep
Caltha palustris	Marsh marigold	light
Dianthus barbatus	Sweet William	light—medium
Dicentra spp.	Bleeding heart	light
Dryopteris	Shield fern, wood fern	light—medium
Echinacea	Coneflower	light
Helleborus	Lenten rose	light—deep
Hosta spp. & cvs.	Hosta or plantain lily	light—deep
Hydrangea	Hydrangea	light—medium
Iris spp.	Iris	light
Leucothoe	Leucothoe	light
Mertensia virginica	Virginia bluebells	light—deep
Polygonatum spp.	Solomon's-seal	medium—deep
Polystichum	Shield fern	medium—deep
Primula	Primrose	light—deep
Trillium	Trillium	light—deep

Cinnamon fern, Jack-in-the-pulpit and violets are grouped pleasingly in a border on a shady side of a house.

Photos by Gottscho-Schleisner

A "wild" garden containing lady's-slippers and ferns graces the also-shaded entrance to the same house.

Ground Covers

Botanical Name	Common Name	Shade Tolerance
Ajuga spp. & cvs.	Ajuga	light—medium
Asarum	Ginger	light—deep
Epimedium spp.	Bishop's-hat	light—medium
Euonymus fortunei	Wintercreeper	light—medium
Festuca	Fescue	light—medium
Hedera spp.	Ivy	light—medium
Liriope	Lilyturf	light—medium
Ophiopogon spp.	Mondo grass	light—deep
Pachysandra	Japanese spurge	light—deep
Tradescantia	Wandering Jew	light—medium
Vinca minor	Periwinkle	light—deep

Annuals

Botanic Name	Common Name	Shade Tolerance
Ageratum	Ageratum	light
Antirrhinum	Snapdragon	light
Begonia	Begonia	light—medium
Calendula	Pot marigold	light
Catharanthus	Madagascar periwinkle	light—medium
Cleome	Spider flower	light—medium
Coleus	Coleus	light—medium
Impatiens	Impatiens	light—deep
Lobularia	Sweet alyssum	light—medium
Nierembergia	Nierembergia	light
Pelargonium	Geranium	light
Petunia	Petunia	light—medium
Portulaca	Rose moss	light
Schizanthus	Butterfly flower	light—medium
Senecio	Dusty-miller	light—medium
Tropaeolum	Nasturtium	light
Viola	Pansy	light—medium

SALT-RESISTANT PLANTS FOR FLORIDA

Mary Jane McSwain

LAWN GRASSES: St. Augustine (*Stenotaphrum secundatum*) or Bermuda (*Cynodon dactylon*) are the best choices. The bahias will tolerate salt in the air, but not in water.

GROUND COVERS: Algerian ivy (*Hedera canariensis*), English ivy (*Hedera helix*), sea purslane (*Sesuvium portulacastrum*), seaside morning glory (*Ipomoea pescaprae*),

A seaside garden containing sweet alyssum, marigolds and petunias weathers potentially damaging salt-laden air without a hitch.

Photo by Gottscho-Schleisner

trailing lantana (*L. montevidensis*), wild lantana (*L. depressa* and *L. aculeata*), beach verbena (*V. maritima*), wedelia (*W. trilobata*), asparagus fern (*A. sprengeri* var.), oyster plant (*Rhoeo spathacea*), purple queen (*Setcreasea pallida*), ice plant or hottentot fig (*Carpobrotus edulis*), fig marigold (*Glottiphyllum depressum*), periwinkle (*Vinca rosea*), coontie (*Zamia pumila* or *integrifolia*), *Sedum* spp., dwarf turf or mondo grass (*Ophiopogon japonicus*), creeping lilyturf (*Liriope spicata*), buttercup (*Oxalis* spp.), juniper (dwarf and spreading spp.: *Juniperus chinensis, J. horizontalis, J. conferta*), Natal plum (*Carissa grandiflora*), dichondra (*D. micrantha*) and snake plant (*Sansevieria* spp.).

VINES: Climbing fig (*Ficus pumila*), night-blooming cereus (*Hylocereus undatus*), Confederate jasmine (*Trachelospermum jasminoides*), wandering Jew (*Zebrina pendula* var.), Mexican flame vine (*Senecio confusus*), flame vine (*Pyrostegia venusta*), pothos (*Epipremnum aureum*) and Virginia creeper (*Parthenocissus quinquefolia*).

GRASSES: Beach panic grass (*Panicum amarulum*), giant reed (*Arundo donax*), sea oats (*Uniola paniculata*), pampas (*Cortaderia selloana*), *Carex* spp. and *Schizachyrium scoparium* (*Andropogon scoparius*).

ANNUALS: Sweet alyssum, candytuft, statice, stock, cornflowers, gaillardia, calendula, daisies, dianthus, marigold, sunflower, zinnia, salvia, portulaca, geraniums (*Pelargonium*), gazania, periwinkle (*Vinca*) and bachelor's-button.

PERENNIALS: Many plants that are classified as perennials in other climates are grown as annuals in Florida. This is due to the nature of our weather pattern. Our climate is generally temperate but with sudden extremes in heat and cold. Many plants are not able to withstand these sudden changes.

Mary Jane McSwain, photo-journalist, garden editor, author, resides in Florida.

Some species in this category are delphinium, alyssum, hollyhock, candytuft, carnation, dusty-miller, begonias, dianthus, *Geranium* and gaillardia. Primrose, shasta and gerbera daisies, rudbeckia, periwinkle (*Vinca*), daylilies, verbena, portulaca, salvia and dusty-miller are more likely to last several years.

Photo by George Taloumis

A bed of ivy geraniums accents the beauty of sea and sand with a cheerful note of brilliant pink.

DWARF OR LOW GROWING FLOWERING SHRUBS USED IN BEDS AND BORDERS: Heather (*Cuphea hyssopifolia*), *Kalanchoe* spp., *Aloe* spp., creeping euonymus (*E. fortunei*), Indian hawthorn (*Raphiolepis indica*), bird-of-paradise (*Strelitzia reginae*), dwarf Chinese holly (*Ilex cornuta* 'Rotunda'), Japanese holly (*I. crenata* 'Helleri'), holly malpighia (*Malpighia coccigera*), Texas sage (*Leucophyllum frutescens*), shrimp plant (*Justicia brandegeana*), gingers and sea lavender or beach heliotrope (*Tournefortia gnaphalodes*).

Perennials:
A Personal Insight into Future Trends

Photo by Roche

Terracing a steep grade and choosing cascading and new compact-growing perennials can provide a stunning succession of borders. This example features bulbs, pansies, phlox and candytuft.

John E. Elsley

Recent years have seen a marked and dramatic increase in the interest and demand for perennial plants by American gardeners—a phenomenon which has persisted in other parts of the world, especially Europe, for nearly a decade. Inevitably, we are now experiencing a world-wide shortage of quality grown, interesting perennials—literally, "demand exceeds supply"—a situation I foresee persisting for a number of years. Producers are now gearing up to meet this demand, which I am confident will remain strong for at least the next ten years. The advent of large-scale micropropagation (tissue culture) is providing quantities of certain perennials faster than by conventional propagation techniques; however, these new methods are expensive and not satisfactory for all perennials.

As with other plant groups, emphasis and demand is increasing for perennials exhibiting compact growth characteristics. The versatile nature of these plants makes them especially valuable for small gardens. Home gardeners are becoming increasingly aware of the importance and value of the improved cultivar selections of various perennial species, many of which must be clonally (vegetatively) propagated, as they do not breed true from seed. Although attractive flower color is still the major reason for selecting a given perennial, increasing emphasis is being given to overall attributes of form (habit), bloom and foliage, and whether or not these extend seasonal interest.

Major breeding work is being carried out in the United States on several groups of perennials for which I see exciting potential. Already, daylilies (*Hemerocallis*) offer us an often bewildering choice of spectacular flower forms and colors. Continued work on such groups as the tetraploids will provide the finest potential for American gardens. Many of the new low-maintenance hosta cultivars have distinct and improved characteristics over most of the old, established favorites. For example, leaf color

can now be retained throughout the growing season. Hostas are of prime value because of their foliage, although in future we can look forward to improved floral characteristics, as well. Peonies are still thought of as old-fashioned, but these sumptuous flowers are once again destined to grace our gardens and interior spaces in increasing numbers and varieties. Although severely hampered by a short blooming season, the tall bearded iris stands alone when floral perfection is a criterion. Each new season seems to reemphasize the art and skill of the plant breeder.

Among the slightly less popular groups of perennials, several are enjoying notable and deserved attention. Astilbes, with their striking flowers and appealing fernlike foliage, are proving their adaptability to a wide range of American climate conditions. By carefully selecting astilbes for their blooming times, they can become one of the longest flowering of all the perennials in the garden. Easy to grow, the true herbaceous geraniums have as much to offer in America as in Britain, where they have become one of the most appreciated and valued of summer performers. Ornamental grasses can provide spectacular and unique enhancement to the landscape. Long appreciated in Europe, especially in Germany, for their extended seasonal appeal and aesthetic nature, grasses adapt successfully to cultivation in virtually every North-American hardiness zone (see p. 64).

Native American flora constitute a treasure house of desirable perennials. We need only mention such plants as *Phlox paniculata* and its selected cultivars to appreciate this assertion. A number of new and exciting *Phlox* are reaching us from England and these have the potential in this country of exceeding their value overseas.

I could go on with this survey ad infinitum, but I think it wise to leave you your share of the excitement of discovery awaiting throughout the vast world of garden perennials.

Photo by Roche

Geraniums, an old standby for color, are being continually improved. Here they are flanked by petunias, ageratum and Mexican zinnias.

Photo by George Taloumis

Variegated hostas, along with smaller-leaved Lamium galeobdolon, *complement an azalea in full bloom. Long valued for foliage interest, hostas in future will have improved floral characteristics.*

John E. Elsley trained at Royal Botanic Gardens, Kew, and worked at Wisley before moving to the U.S. He was Curator of Hardy Plants at Missouri Botanical Garden before becoming Assistant Vice President, Wayside Gardens.

PROBLEMS WITH STARTING SEEDS

Ray R. Rothenberger

Tomato seedlings are often started indoors for moving into the garden when temperatures moderate. Too little light will sometimes result in weak and spindly stems. Those shown here are sturdy and compact.

Seedlings grown in Jiffy-™s can be planted, as is, directly into the garden, reducing the shock of transplanting. Roots can be seen growing through the sides of the peat containers.

A common problem for the gardener who starts plants from seeds indoors is spindly seedlings. Seedlings that have long, thin stems beneath their seed leaves not only tend to collapse, but are more subject to stem diseases, such as damping-off.

When moved outdoors, thin stems are easily sunburned unless caution is taken to acclimate them slowly and carefully. Even without damage, these plants often develop more slowly than those that grow from seedlings with stout, short stems.

The most common causes of spindly seedlings are too little light, temperatures that are too high or a combination of both conditions at the time the seedlings emerge. While seeds may germinate rapidly at high temperatures, the extra stem length that results is not desirable.

While seeds may be kept in low light or even darkness during germination, as soon as there is any sign of an emerging seedling, the pot or flat should be moved to very bright light.

Which window is best for the greatest amount of natural light? Remember, many vegetables and flowers will be planted into a garden that gets full sunlight. These plants need high light intensity in the seedling stage, as well as later.

Large windows facing south and providing the most intense light for the longest duration, are ideal. West windows are also useful, but light duration is shorter. East windows might be the next choice and north windows should be used only for shade-loving plants. Even then, east and north windows may not provide enough light for compact growth.

Sturdy tomato seedlings are ready for planting. Starting these under fluorescent lights at the proper distance will insure their compactness.

Photos by George Taloumis

Seedling tomatoes in Jiffy-7s contrast with those started in one large container. The former are ready for the garden, while the roots of the latter will have to be disturbed as a result of separating and transplanting.

Vegetable, annual-flower and some perennial-flower seeds may also be started under artificial lights. Fluorescent lights are best. Use adjustable fixtures, so that the tops of the seedlings can be kept six to ten inches from the tubes at all times.

Light intensity is highest at the center of the tubes and drops off toward the ends. Burn lights over seedlings no less than 14 hours per day, and preferably 18 hours. Indeed, many seedlings will benefit from continuous artificial light.

Another factor to consider is temperature. While many seeds germinate well at 70 degrees F., they may also do so at 60 to 65 degrees F. Avoid temperatures higher than 70 degrees. The germination time will be slowed a little, but in the home, seedlings provided with adequate light will be more compact. Cool-season crops, such as cabbage, may be started at a cooler temperature, close to 55 degrees F. Gardeners with a home greenhouse or hotbed will find that spindly seedlings will be less of a problem.

Of vital importance in growing seedlings is cleanliness. A common problem, a fungus disease called damping-off, can prevent seeds from germinating, or cause young seedlings to collapse at the soil line. The small stem first takes on a water-soaked look and becomes constricted. Eventually it is unable to support its small leaves and topples over. It will die in 24 to 48 hours.

In some cases, seedlings survive the infections, but growth is greatly reduced. The best means of elimination is prevention — using non-contaminated soil. Sterilize a small batch of soil mix by placing it moist, but not wet, into a baking pan. Cover with aluminum foil, seal down the edges and bake at 200 to 220 degrees until a meat thermometer placed into it reads 160 degrees. Maintain this temperature at the center of the soil mass for at least 30 minutes. Heated soil gives off a pronounced odor, so good ventilation is advised.

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SOILS

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Soils

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BROOKLYN BOTANIC GARDEN RECORD

SOILS

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HANDBOOK #110

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There are thousands of soil types, each with different abilities to supply plants with water and nutrients and allow roots to penetrate deeply for support and drought resistance.

Photo Courtesy USDA Soil Conservation Service

FUNCTIONS OF SOIL

ROY L. DONAHUE, JOHN C. SCHICKLUNA
AND LYNN S. ROBERTSON

From soil plant roots receive mechanical support, essential nutrient elements, water and oxygen.

Soil *physical* properties largely determine a soil's water-supplying capacity to plants. Soil *chemical* properties determine the soil's nutrient-supplying capacity. Both physical and chemical properties determine root extension and the volume of soil that serves as a reservoir for both water and essential nutrients for plants.

Some soils are in a physical and chemical condition that encourages plant roots to grow deeply and extend

long distances laterally. These soils are ideal because the plants growing in them will not blow over, will be drought resistant and capable of absorbing nutrients from a large volume of soil. The growth of plants can be restricted by naturally or artificially compacted or infertile layers, too much or too little soil moisture or soluble salts in toxic quantities.

At present sixteen elements are known to be essential for the growth of most plants: carbon, hydrogen and oxygen from air and water; phosphorus, potassium, sulfur, calcium, iron, magnesium, boron, manganese, copper, zinc, molybdenum and chlorine from soil; and nitrogen from both air and soil.

Essential Elements for Plants from Air and Water

Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N)

Essential Elements for Plants from Soil and Fertilizer

Major Nutrients	Nitrogen (N)
	Phosphorus(P)
	Potassium (K)
Secondary Nutrients	Calcium (Ca)
	Magnesium (Mg)
	Sulfur (S)
Micro-nutrients	Iron (Fe)
	Boron (B)
	Manganese (Mn)
	Copper (Cu)
	Zinc (Zn)
	Molybdenum(Mo)
	Chlorine (Cl)

From ***Soils: An Introduction to Soils and Plant Growth*** by Donohue/Shickluno/Robertson; 1971. Reprinted by permission of Prentice-Hall, Englewood Cliffs, NJ.

Water and air occupy pore spaces in the soil. Following a heavy and prolonged rain or irrigation, soil pores may be almost completely filled with water for a few hours. After a day or two some water will have moved downward in response to gravity, and the larger pores will be emptied of their water but filled with air. With a further loss of water by evaporation or transpiration, air will replace more of the space occupied by water. The next soaking rain, or irrigation, repeats this process.

The important part of this air-water relationship is that there must be enough total pore space and that the pore spaces must be the proper size ranges to hold enough air and water to satisfy plant roots between cycles of rainfall or irrigation.

From the soil plants accumulate nitrogen, phosphorus and sulfur. In other words, plants nearly always contain a higher percentage of these elements than the soil in which the plants are growing. Conversely, soils almost always contain more iron, calcium, potassium, magnesium and manganese than the plants growing in them.

Essential Elements for Plants

Nitrogen was first proved to be essential for plants in the eighteenth century; seven more elements were proved essential in the nineteenth century; and thus far in the twentieth century, eight additional elements have been shown essential. As a result of more refined research methods, other elements probably will be proved necessary.

Plants contain sodium, iodine, selenium and cobalt, which have not yet been proved essential for plants but are a necessity for the people and animals who eat these plants. Although sodium

ncreases the growth of certain plants, it as not been demonstrated as essential. Silicon and aluminum also occur in all plants, but apparently they serve no useful function. Throughout the world oday, soil is the principal supply source of essential elements for plant growth. Fertilizers and manures are used only as supplement. Green-manure crops unction primarily to make existing soil nutrients more readily available.

Soil is the source of thirteen of the sixteen elements essential for plant growth. Twelve of the thirteen elements originated in the parent rock from which the soil developed. (Nitrogen was present in some parent rock in very small quantities.)

The total supply of plant nutrients in the soil is therefore of fundamental importance to the economic production of plants. Although it is true that plants can be grown in pure quartz sand when essential water, air and nutrients are supplied, economic production is seldom possible by this technique.

Fertilizing Perennials

(These Guidelines Can Also Be Used For Annual Flowers)

After years of declining popularity, herbaceous plants are making a fast comeback. Recent years have brought a surge in gardening interest, and perennial plants are being used more often in borders and mixed plantings. As people spend more time gardening with perennials, they are developing a genuine interest in learning good cultural practices. Long-term success with perennials, just as with woody plants, depends upon providing a suitable root environment. If other cultural requirements are met, perennials will benefit from proper fertilizer applications. Guidelines for fertilizing perennials are as follows:

In early spring (February or March) use a complete slow-release fertilizer with a 1:1:1 ratio, such as "10-10-10." Apply a surface application of fertilizer at the rate of 1 lb. of nitrogen per 1,000 sq. ft.

By late May, weak solutions of liquid fertilizer applications may be applied frequently. A highly soluble fertilizer, applied in two-to three-week intervals from late May through late July is suggested.

Read the label and adjust the application rate according to how often the fertilizer is applied. (The more frequent the application of fertilizer, the weaker the solution should be.) If the perennials have lush foliage growth and few flowers, reduce or eliminate the liquid fertilizer applications.

Stop fertilizing in late July and apply one more application of slow release fertilizer in late fall. Apply at the rate of 1 lb. of nitrogen per 1,000 sq. ft. This late application will promote root growth before the ground freezes hard and will increase productivity the following season.

Mary L. Wilmoth
Propagator; The Dawes Arboretum

PHYSICAL PROPERTIES OF SOIL

JOHN PAUL BOWLES

Thousands of soil types exist. Soils are classified according to a complicated and detailed system not unlike that used to arrange and show relationships between plants. Phylum, Class, Subclass, Order, Family, Genus and Species are the terms (broad to specific) used to name plants. Order, Suborder, Great Group, Subgroup, Family, Series and Phase are used to name soils.

These classifying divisions tell soil scientists the origin of the soil — what type of rock the soil is derived from and how the soil particles got there (wind, water movement, etc.) — about the natural plant cover, how deep is the soil, what type of horizons or layers are present, physical properties (textural qualities, organic content, nutrient content, structure) and more. Most of the information pertaining to soil classifying divisions is useless to home gardeners because it is so filled with unfamiliar terms and definitions. But at least the last or most specific category — Phase — is easier to explain and more useful for gardening decisions.

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Phase, also called Soil Type, is not officially recognized in the United States system of soil taxonomy, in part because it repeats analyses of physical soil properties included in other categories. These soil properties, however, are most measurable and useful to ornamental and food-producing gardeners. A description of a Soil Type or Phase includes the kind, size and percentage of soil particles (sand/silt/clay), percentage of organic matter, references to mineral ion content (high aluminum, low phosphorus, etc.), soil consistency (the amount of resistance to tilling) and soil structure (the kind and amount of soil particle aggregates).

Land is also classified by its agricultural capability. Most of the earth's surface is covered by water. Much of the remaining area cannot (or should not) be cultivated because it is too poor or mineralally unbalanced, too dry, too rocky, too steep, and so on.

Only about two percent of the land in the U.S. is ranked as Class 1 in land capability. Class 1 land is relatively flat and well-drained with rich, deep, well-structured soils. But with good management and/or irrigation, between 20 to 42 percent of the remaining land is suitable for

egular cultivation. The U.S. is unusually vell-favored in this regard, for in many ountries, particularly those in tropical limates, the percentage of even narginally arable land is very, very low.

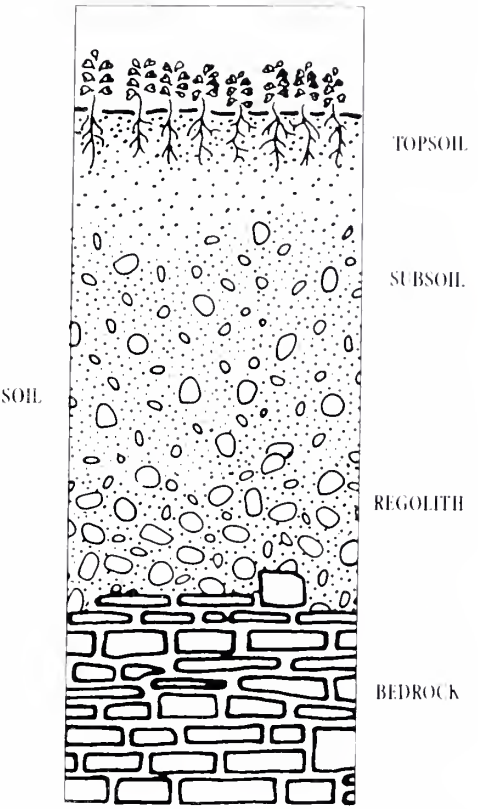
What Is Soil?

Before discussions of soil management an begin, just what soil is must be deternined. Soil is in the upper portion of a part of the earth's crust called the egolith. The regolith is a layer of uncon-olidated debris (boulders, rocks, stones, gravel, sand and the even more weath-ered materials, clay and silt dust) found above bedrock.

In some places the regolith is very hick, in others very thin or even absent. But in general, the regolith covers land n a coat thick enough so that the soil is rom three to six feet deep. *Soil* becomes lifferentiated from the regolith by the veathering actions of wind, water and eat, and because plant roots, surface rganic deposits (plant and animal emains) and the activities of animals nd soil microorganisms have added rganic matter. Just as weathering and rganic matter sort soil from the egolith, more weathering and a high uantity of organic matter make *topsoil*. All plant roots are found in soil and most re found in topsoil.

Most of the world's soils are mineral oils because the organic content, even n the topsoil, is very low — usually five ercent or less. The rest of the bits and ieces that make up "dirt" are soil parti-les (various and sundry minerals).

When describing soil, these particles re called *soil separates*: sand, silt and clay. Sand particles are the largest, clay the smallest; in fact, individual clay particles re microscopic. The percent compari-on of soil separates decides how a particular soil textural type, such as sandy clay, loam and loamy soil, is named.



The regolith over much of the earth is very deep, but soil and topsoil vary considerably in depth. Sometimes the regolith is entirely soil, in which case it is usually thin and rests directly on bedrock.

Soil consistence refers to the resistance of a soil to rupture, i.e. tilling. Soil consistence is described in different ways depending on soil-moisture conditions. *Friable*, a term every gardener has heard, refers to a moist soil that crushes easily with gentle pressure but will hold together when pressed. This is the best condition a soil can be in, both for plant growth and cultivation. Soil *tilth* is often

referred to in gardening and agricultural tests; tilth is the physical condition of a soil as related to its ease of tillage, fitness as a seedbed and impedance to seedling emergence and root penetration. A soil with good tilth and friability makes for a very good garden.

Consistency, tilth and friability are dependent on soil texture and on *soil structure*. The structure of a soil refers to the way in which its individual particles cling or *aggregate*. Soil structure is a very important quality because it determines how effectively air and water move into and through the ground.

If a clay soil is non-aggregated, spaces between particles, called *pores*, are so tiny that water, and even air, will not move or *percolate* (flow) down, and plant roots "suffocate" from lack of air or too much water. If a very sandy soil contains no aggregates, then there is nothing to impede the flow of water, and plants suffer from drought. Naturally formed aggregates are called *peds*; unnaturally formed aggregates, such as are made when tilling a too-wet clay soil, are called *clods*. Clods are undesirable mainly because their formation ruins natural soil structure by mashing peds into too-large clumps. Aggregation that's best for plant growth is present in a soil that appears grainy, not chunky; desirable soil aggregation occurs almost exclusively on a microscopic level.

Garden plants require both water *and air* at their roots. Clay soils, because of a multitude of tiny particles, have more total pore space – pore space in the "blank" area between soil separates – than sand soils. But the pores in clay soils are often *too* small for good air or water movement. Water is held in great quantities in clay soil pores but much of it is unavailable to plants. Sand soils, on the other hand, may have excellent drainage and good aeration, but are not able to store water. So in a way, very clayey and very sandy soils have the same problem: poor pore structure; sandy soil is too loose and dry, and clayey soil is too tight and airless. For home gardeners who must work with the soil they have, yet want to grow a variety of plants in favorable conditions, the management and improvement of soil is of the utmost interest and importance.

It is essential that you not overtill soil when preparing it for planting. A pulverized or powdery soil is *not* best for plant growth. And if you use a mechanical tiller, be advised that, as it breaks up topsoil, the pressure of its weight forms a compaction below the area being tilled – sort of a big, flat clod (or pan) that will resist water movement and plant roots.

Why is all this noteworthy to you? 1) For best growth of most ornamental and edible plants, a friable, well-drained, airy, yet moisture-rich, soil is desirable; loose soil with lots of "good" pore space, yet also lots of water holding capacity. 2) Most agricultural soils, and of course the soil around your home, are mineral soils that may be heavy, compacted or poor. 3) Any soil texture type that has a good structure is easier to till and promotes better plant growth. 4) You *can* do things to increase desirable soil aggregation. What? One thing that is easy to do is to disturb soil as little as possible. Native soils often have a decent structure, and a disturbed soil, if let alone, may eventually re-develop its original nature. Disturbances include more than tilling; normal foot traffic or as simple but constant an activity as mowing can cause enough soil compaction to qualify as disturbances. One positive step you can take to encourage appropriate aggregation is to add organic matter.

But how you do all this – evaluate your soil and decide how to manage and/or improve it – is another matter, and that's what this handbook is all about.

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Determining Soil Textural Class

How To Use This Diagram

Along the labeled triangle sides, locate points corresponding to percentages of silt, sand or clay present in a soil under consideration. From each of those points, draw a straight line inward, parallel to the side adjacent in a counterclockwise direction. The name of the compartment in which the lines intersect becomes the class name of the soil in question.

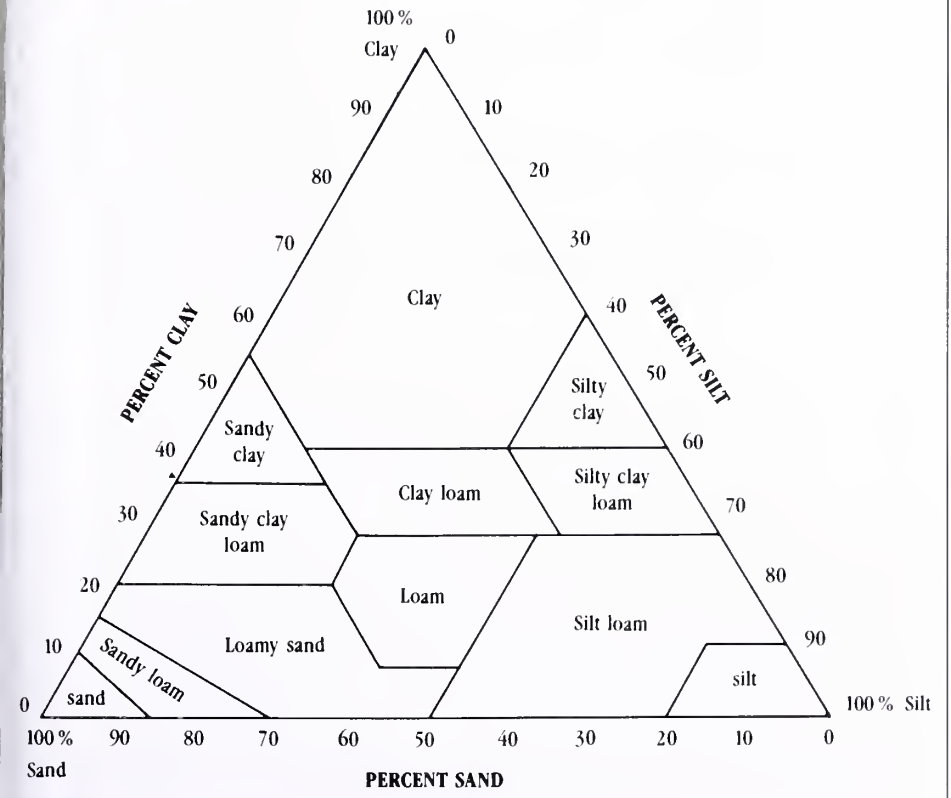
Using the "Feel" Method to Determine Textural Class

When a small amount of dry soil is rubbed between forefinger and thumb:

Sand feels gritty and is not moldable or sticky.

Dry **silt** has a floury or talcum-powder feel, is only somewhat moldable and sticky when wet; dry clods are somewhat difficult to crush.

Clay is very moldable when wet; dry clods are extremely difficult to crush.



General Terms Used to Describe Soil Texture in Relation to the Basic Soil Texture Class Names

Sandy Soils	Loamy Soils			Clayey Soils
Coarse	**Moderately coarse**	**Medium**	**Moderately fine**	**Fine**
Sandy Loamy sands	Sandy loam Fine sandy loam	Very fine Loam Silt loam Silt	Clay loam Sandy clay loam Silty clay loam	Sandy clay Silty Clay Clay

Graphic Guide to Textural Classification

Because of the small scale of the chart, it is not possible to show all recognized soil textures in the sandy range.

Soil Separate	Diameter Range (mm)	Comparison to U.S. Monetary System (Dollars)
Very Coarse Sand	2.0 -1.0	2.00-1.00
Coarse Sand	1.0 -0.5	1.00-0.50
Medium Sand	0.5 -0.25	0.50-0.25
Fine Sand	0.25-0.10	0.25-0.10
Very Fine Sand	0.10-0.05	0.10-0.05
Silt	0.05-0.0002	0.05-
Clay	less than 0.002	

Mineral fragments in the soil larger than two millimeters in diameter (gravel) are not strictly a part of the soil, but must be recognized because they greatly influence the use of land. For example, a sandy loam that contains a larger amount of gravel becomes a gravelly sandy loam.

Organic soils are rather rare. Soils are classified as *organic* when organic content is between 20 and 30 percent by dry weight. Considering the light weight of dry organic matter, a true organic soil contains a very, very large amount of organic material. (A soil test can tell you the percent of organic matter in a soil sample.)

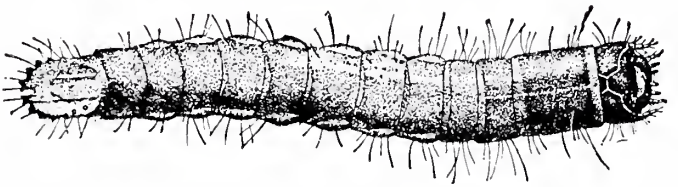
Lawn Clippings

To Remove or Not To Remove

Must you remove lawn clippings? *Only* when the clippings are thick enough to mat together and smother the grass beneath them. But then, you should never remove more than one inch of grass when you mow, and one inch of clippings will not smother grass. In fact, when grass is mowed properly, the next day after mowing, clippings will seem to have disappeared. Why? Because clippings are over 90-percent water and quickly dry up to almost nothing. It's for this reason that clippings do *not* contribute significantly to thatch. Many other cultural practices cause thatch, but the removal/non-removal of clippings has very little to do with it. So mow grass to the proper height—two inches or more for most lawn grasses—and mow often enough so that clippings won't be a problem. Note: Uncollected clippings return nutrients and organic material to the soil.

SOIL ORGANISMS

STEVEN J. THIEN AND
BARBARA DANIELS HETRICK



Wireworm

The soil environment supports a vast amount and array of organisms. Their importance depends on each organism's ability to influence soil properties and plant growth. Without the collective activities of the multitude of organisms it harbors, soil would be an inert medium incapable of supporting unassisted plant growth. Instead, a productive soil constitutes an ecosystem alive with organisms, seen and unseen, responding to the energy level and climatic limitations of their unique environment.

Types of Soil Organisms

In addition to miles of plant roots, almost innumerable organisms populate soil. These include both plants (flora) and animals (fauna), which can be further categorized into micro- (small) or macro- (large) sized types. Although macroorganisms are most noticeable, the microorganisms exert a more pronounced influence on vital soil processes. Microorganisms are responsible for organic matter decomposition, nutrient cycling and other wide-ranging effects on plant growth.

MACROFAUNA. Nematodes are by far the most numerous of soil animals, but even though classed as macro-sized, are still too small to be seen. Other macrofauna include: snails, slugs, earthworms, woodlice, springtails, millipedes, centipedes, termites, beetles, ants, spiders and mites. Macrofauna are involved in the initial stages of the breakdown of surface organic residue and its incorporation into the soil. Other animals, such as rodents and snakes, inhabit the soil

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for a part of their existence, but are less important to soil dynamics.

Microfauna. Soil harbors few of these organisms. Protozoa are the most notable; mainly they parasitize other soil organisms.

Macroflora. Plant roots are the most obvious in this group. The metabolic activity of roots has a marked effect on soil properties and, hence, on the activities of other organisms.

Microflora. This category of soil organisms is the most influential. Members include: bacteria, fungi, actinomycetes, algae and viruses.

Bacteria are single-celled organisms occupying favorable niches as colonies of many cells. In a rich environment, 1,000,000,000 bacteria cells may occupy a cubic centimeter of soil.

Fungi usually account for the largest portion of the total soil microfloral mass. Fungi permeate the soil as threadlike networks of filamentous material called mycelia. One gram of soil can contain as much as fifty meters of fungal mycelia.

Actinomycetes produce single-celled colonies like bacteria, but also permeate the soil with slender mycelia. Actinomycetes normally compose ten to fifty percent of the microfloral soil population, but may dominate the microflora population in dry, alkaline conditions. The familiar aroma of freshly-turned earth originates from these organisms.

Algae possess chlorophyll and need access to sunlight, so populations are confined to the surface layer of soil. Their inability to compete with other organisms except under certain circumstances limits their influence to very wet conditions. Blue-green algae, however, are some of the few free-living organisms that can incorporate atmospheric nitrogen into plant-available organic compounds.

Viruses are the smallest soil organisms, being perhaps twenty times smaller than bacterial cells. They rarely exist free in the soil, but instead invade other soil organisms, frequently becoming pathogenic (disease producing).

Soil Organism Activity

The amount of carbon in soil determines the energy available for soil organism activity. Nowhere is this relationship more evident than in the process of organic matter decomposition.

Plant residue, when added to soil, is changed into humus by the chemical actions of soil organisms. First, macroorganisms reduce the size of the residue material and mix surface residues into the soil. Then microflora, predominantly bacteria and fungi, further decompose the residue by extracting energy stored in molecular chemical bonds. This process releases nutrients and carbon dioxide as by-products. The original residue is by now converted to a new compound called humus.

Humus is nitrogen-enriched when compared to the original residue, and gives soil a dark coloration. Humus acts as a storehouse for both water and nutrients; humus granulates and loosens soil, encouraging better root, air and water penetration. And humus provides a carbon energy supply that encourages beneficial microfloral activities.

During organic matter decomposition, soil organisms release nutrients from residues and make them available to plants. Most notably, nitrogen, phosphorus, sulfur and boron are converted from complex organic forms to the simple mineral forms required for plant growth. Through this series of processes, called mineralization, the recycling activities of soil organisms increase soil fertility.

The small zone of soil immediately adjacent to a plant root abounds with soil organisms. This zone contains microfloral activity ten times (or even several

hundred times) that observed in soil farther away from roots. The intimate association between plant roots and soil organisms provides the ideal environment for plant and soil organism interaction. For example, many soil organisms produce growth-regulating compounds that stimulate plant growth; other substances act as toxins and are harmful to growth. Some microorganisms act as a sort of defensive shield and suppress damaging organisms. All soil microorganisms utilize enzyme systems to aid specific chemical reactions, which are often beneficial to plant roots. Once understood, the regulation of plant root and microorganism interaction holds promise as a tool in soil management for plant production.

Soil Management and Soil Organisms

In general, a healthy soil is characterized by an abundance of soil organism activity. Gardeners should strive to keep soils well supplied with carbon-containing residues (dead plant material) to maintain active beneficial soil microorganism populations. Rotating plant types on a particular site is also beneficial, as this practice prevents the build-up of undesirable organisms.

The key to suppressing disease organisms is to encourage and maintain good plant health. Plants experiencing moisture, temperature, fertility or aeration (compaction) stress are more vulnerable to disease or pest invasion. Growers should develop and maintain soils that provide ample drainage and aeration. Too low/high pH or nutrient deficiencies/toxicities should be corrected and organic residues incorporated to stimulate soil organism activity.

Controlling Undesirable Organisms

At some time most growers are faced with controlling undesirable soil organisms. The approach and chance for success varies with the type of organism.

Macrofauna Control. Small-mammal control is difficult. Poisons, fumigants and traps are available, but a successful program may have to include more than one technique. Burrowing animals, such as ground squirrels and moles, can cause considerable damage by building extensive tunnel systems. These tunnels also provide soil access to field mice and insects.

Poisoned food baits are effective for squirrels and mice, but are extremely toxic and should be used with caution. Moles feed mainly on earthworms and grubs and are not easily controlled with bait poisons. Controlling grubs in lawns forces moles to look elsewhere for food; or they can be exterminated with traps or poison-gas cartridges discharged in their tunnels.

Nematode Control. Nematodes are microscopic, wormlike animals that inhabit nearly all soils. Most nematodes feed on bacteria, but a few species possess a hollow, needlelike mouthpart called a stylet, which is used to pierce roots and extract plant juices. While feeding, plant-parasitic nematodes inject a chemical which causes roots to swell or knot and develop galls or lesions.

Excessive branching of roots or stubbiness are also signs of nematode feeding. The wounds caused by feeding nematodes provide entry sites for bacteria and fungi, and in this manner nematodes facilitate root rot and other diseases.

Above-ground symptoms of nematode damage are reduced growth, yellowing of leaves excessive wilting and reduced yields. But since symptoms of nematode damage can be similar to symptoms of nutrient deficiencies or disease, it is always advisable to seek professional diagnostic advice.

The objective of nematode control is

to reduce the population of nematodes to a point where adequate plant growth and yield is achieved. Cultivation helps reduce nematode populations by injuring them and exposing them to drying by the sun and wind. Nematode control is aided by removing the host plants through fallowing, or planting a nematode-resistant plant for one season or more. Early crop-residue disposal, the use of resistant varieties and crop rotation may starve the pests. Asparagus and marigolds release toxic substances that decrease some nematode populations. Steaming or heating small quantities of potting soil at 350 degrees Fahrenheit for one hour effectively kills nematode populations; however, nematodes are rarely a problem in houseplants.

In addition to cultural practices, nematicides (chemicals toxic to nematodes) offer a control option. Nematicides must be applied to bare soil, but can greatly reduce nematode populations. Some nematicides also control fungi, bacteria, insects or weeds. Unfortunately, the most effective agents, such as methyl bromide, are highly dangerous and should be used only with the recommendation and supervision of specialists.

Soil-borne Pathogen Control. Some soil organisms (certain types of fungi, bacteria and viruses) can invade roots and become pathogens (disease-causing organisms). They pose special problems to growers since they are almost impossible to detect and rank as the most difficult of all disease agents to control. Soil-borne diseases are responsible for most crown and roots rots, wilts, blights and smuts. These organisms are very common and most gardeners are at some time faced with their control. The most serious diseases usually spread rapidly and appear year after year. For these diseases, control is aimed at prevention rather than cure and usually involves a combination of practices.

The best control for a disease is to restrict it from entering new regions. Once introduced, pathogens can quickly reach epidemic proportions. Federal and state laws regulate the importation and distribution of soil and plant materials to eliminate just this possibility. Home growers trading plants should likewise beware of introducing disease organisms.

In the home garden, good cultural methods for plants afford some degree of control by creating unfavorable conditions for plant pathogens. And plants in good growing environments are more resistant to pathogen damage. The spread of disease organisms is restricted where soil management encourages rapid organic-material decomposition. Practicing proper sanitation by promptly removing and destroying infected plant material and weeds may interrupt the life cycle and decrease the population of a pathogen.

Use of disease-resistant varieties offers the single most efficient method of biological disease control. Some pathogens cause disease only in very specific groups of plants. By growing plants that are unsuitable hosts, pathogen populations can be decreased or in some cases totally eliminated. A new biological control strategy being investigated uses beneficial microorganisms to regulate pathogenic organisms. Some day this may be a common method of combating disease.

Heat is an effective method for controlling undesirable soil organisms. Steaming (using moist heat) soil to an internal temperature of 190 degrees Fahrenheit for at least thirty minutes kills most insects, weed seeds and soil pathogens. With dry heat, one hour at 350 degrees Fahrenheit is required. But both these methods are not feasible for home gardeners and can be damaging to the soil itself. However, in some climates solar heat can be used to "steam" soil i

he soil is kept moist and covered with ransparent plastic during the hottest eriod of the year. If the soil can be kept round 120 degrees Fahrenheit for two eeks, pathogens that cause wilts and oot rots may be controlled.

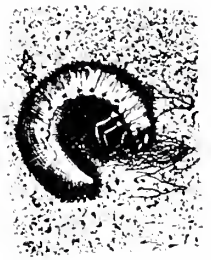
It is important to note that steaming ot only destroys soil organisms (good nd bad), but also alters some physical nd chemical properties of the soil. leavy clay soils may become more granlar with steam, often improving lrainage and aeration. After steaming everal applications of water may be necssary to moisten the soil thoroughly. In ighly organic soils, steaming can cause mmonium nitrate to accumulate in quantities large enough to burn roots nd foliage of sensitive plants. Other ninerals may also increase toxic levels if oils are over-heated. Avoid repetitive eat treatments, excessively high temperatures and longer-than-necessary periods of heat.

Chemicals provide another means of disinfecting soil seeds and bulbs and controlling plant diseases or the insects that carry and spread diseases. As a rule, chemicals applied to plants seldom cure diseases brought on by soil organisms; rather, they are protectants that reduce or prevent the *spread* of disease. Seeds, seedlings and bulbs can be treated with chemicals to protect them from soil pathogens. Examples of such chemicals are zineb, maneb, thiram and chloroneb. Damping-off, seedling blight and crown and root rots can be controlled with soil-applied fungicides, such as those just listed.

Soil can be treated directly with another class of chemicals, called fumigants, that control some pathogenic fungi, bacteria and nematodes. Some fumigants disperse slowly through the soil, others are highly volatile and the soil must be covered with plastic to prolong their effect. Common fumigants are chloropicrin, methyl bromide, and vapam; all are very dangerous and should be used with extreme caution.

Fumigants are very potent chemicals, toxic to plants, animals and people. They kill all forms of vegetation, so soil near desirable trees, shrubs or other plants cannot be treated. Fumigants vary in their ability to move through the soil, but all require loose and moist conditions for optimum effectiveness. Most have waiting period of one to four weeks before safe seeding or replanting can take place.

Most gardeners find diseases difficult to diagnose. But the specific pathogen must be identified before an effective control program can be implemented. In most cases, recommendations on chemical and cultural control practices should be sought from specialists.



White grub

MYCORRHIZAE

They Can't Help but Help Plants

Gary W. Watson

Plant root systems cannot penetrate every area of the soil. Even the smallest root tips are much larger than soil micropores. Soil micropores are the tiniest of soil spaces and surround individual soil particles. These microscopic openings make up the bulk of soil pores and could provide access to tremendous amounts of nutrient ions if plant roots were small enough.

A symbiotic (or mutually supportive) relationship that overcomes this problem has evolved between plant roots and soil fungi. Certain fungi and plant root systems grow together, each becoming an extension of the other. The fungi produce structures that are called mycorrhizae. Mycorrhizae are not roots, but for ease of comprehension can be thought of as such. They go unnoticed because they usually cannot be detected with the naked eye. On a few plants, the bright color of the fungus can be observed as it covers the surfaces of plant roots.

Several types of mycorrhizae exist, each differing in structure, but with similar function. In each type the fungus actually grows from the soil into the fine root tips of a plant and establishes a mechanism for nutrient exchange between the two organisms. The fungus uses the plant as an energy source, receiving sugars that have been manufactured by photosynthesis in the leaves and transported down to the roots. The plant receives nutrient ions in return.

When mycorrhizal relationships are present, a network of extremely fine fungus strands extends from the root for many inches into the surrounding soil. This fungal network acts as an extension of the root system, penetrating areas of the soil that the roots cannot reach and absorbing and transporting nutrients back to the plants.

In nature only a few plants species and special soil situations are known where plant roots totally lack mycorrhizae. But site factors do influence the degree of mycorrhizal association. On infertile soils, growth of mycorrhizal plants far exceeds nonmycorrhizal plants. But on sites of high fertility, the effectiveness of mycorrhizae diminishes, and may be poorly developed. Also, wet sites have less mycorrhizae than dry sites.

At this time there are no reliable procedures or aids known to encourage mycorrhizae and their benefits. But research on this topic is increasing and someday the management of mycorrhizae may be as important as the use of fertilizer.

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LIVING THINGS IN THE SOIL

What They Do for You, What You Do for (and to) Them

John Paul Bowles

As discussed in the previous article, *Soil Organisms*, the ground under our feet is full of life. So many things live there you almost expect the earth to churn and quirm.

Many organisms live in soil: bacteria and various other kinds of microorganisms (living things too tiny to see with the unaided eye), higher plants (roots mainly), earthworms, ants and other arthropods, beetles and their larvae (grubs), other kinds of insects, slugs, snails, nematodes, fungi (mushrooms, puffballs, mycorrhizae, etc., and many microscopic forms such as molds and yeasts), protozoa (microscopic animal life), mice, moles, groundhogs and who knows what else? A handful of soil may contain billions of organisms.

Both animal and plant life depend on soil organism activity.

Bacteria are the most numerous and arguably most important soil organisms. There are many kinds of bacteria. Some of the most beneficial types convert atmospheric nitrogen (all plants require nitrogen to live) into forms plants need. This is called nitrogen fixation — something plants cannot do for themselves. Some plants (such as peas and other legumes) have nitrogen-fixing bacteria that live right in their roots.

Other bacteria, and another group of microorganisms called actinomycetes, are responsible for the decomposition of dead things, a useful task, if not for the sake of good housekeeping, then certainly for the advantages of recycled nutrients.

Some soil microorganisms have antibiotic qualities. Penicillin and Streptomycin, familiar because of their use as human medicine, are produced in quantity by soil fungi and actinomycetes. It is thought that soil antibiotics help control some plant diseases.

The activity of decomposition microorganisms provides very useful by-products: carbonic, nitric and sulfuric acids. These acids are essential in both the formation of soil and for plant growth, as they dissolve rocks and turn minerals needed for plant growth from insoluble (unusable) to soluble (usable) forms. Besides slowly dissolving rocks into smaller particles, many types of soil microorganisms and their by-products aid in the "cementing" of tiny soil particles into bigger aggregates, and thus improve soil tilth.

Many other creatures such as ants, centipedes, various mites, springtails, earthworms and nematodes (a kind of microscopic animal) participate in the breakdown of dead material. And the physical movement of most of these animals, particularly earthworms, is

A good mulch will encourage desirable soil organisms.

PHOTO BY ELVIN MCDONALD

important for soil building and conditioning. Mammals that live in-ground also contribute to the development of better soils for plant growth. Plants themselves help build better soils as their roots grow, loosening heavy matter and even breaking stones. Plants also contribute a large quantity of the dead material required for the life of most beneficial soil organisms.

So healthy soils are teeming with life, but all things that live in soil are not conducive to the health and welfare of plants. There are soil-borne disease organisms, and most people are aware of the detrimental feeding effects of some kinds of nematodes and the grubs of beetles. Anyone with a lawn has been irritated by the tunnels of moles (which, by the way, almost exclusively eat the grubs that almost exculsively eat grass roots).

Is there any way to encourage "good" soil organisms while discouraging "bad?" Not so very long ago the use of non-selective soil fumigants and sterilants was often advised for garden soils, and sometimes still is for particularly severe problems. However, these products usually do more harm than good by also killing the multitude of desirable organisms. Selective chemical treatment for undesirable pest or disease control is better than a soil sterilant. For example, use a selective nematicide to get rid of nematodes (but only when you are *certain* that you have a severe nematode problem).

An even better method to encourage desirable organisms at the expense of undesirables is thoughtful and timely management. Remove or treat diseased plants promptly, and grow plants tolerant of the site (a plant that prefers sun but is planted in shade is prone to more disease problems). Keep soil pH in the good growth range (5.5 to 6.8), and nutrients at desirable levels (use soil tests!). Mulch whenever possible and manage lawns so that clippings don't have to be removed and dead organic material (that becomes microscopic food!) is present.

The management of soil pH, nutrients (particularly nitrogen) and organic matter is vitally important to the well-being of the kind of soil organisms (including earthworms) that build or maintain healthy soils. A healthy soil is good for plants and good for you. ❦

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LIVING QUARTERS FOR PLANT ROOTS

HENRY C. DE ROO

Soil is the living quarters of an important part of most plants, the roots. Frequently half of a plant or even more, consisting entirely or largely of roots, lives and grows in the soil.

HENRY C. DE ROO, *now retired, was soil scientist for The Connecticut Agricultural Experiment Station, Valley Laboratory, Windsor, Connecticut.*

The main function of roots is to anchor the plant and to supply it with the nutrients needed and enormous amounts of water, all of which come from the soil.

For most species of plants, there is a rather definite relation between root and top growth. It follows then that a well developed, healthy root system is essen-

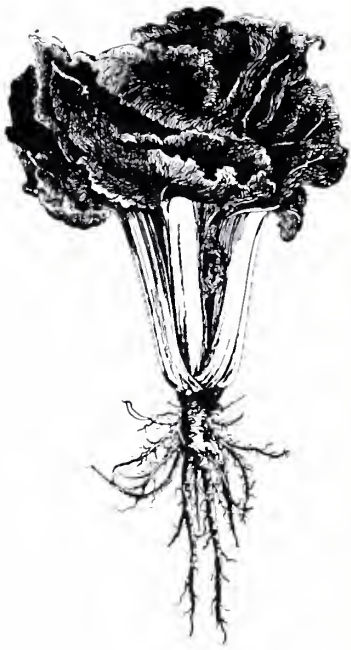
Often half of a plant or even more, consisting entirely or largely of roots, lives and grows in the soil.

tial for the production of a vigorous plant.

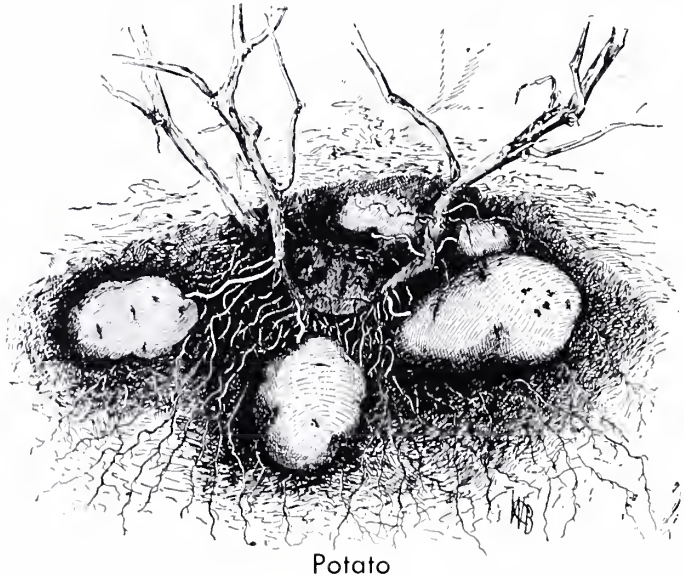
These facts are so commonplace that there is danger of forgetting them. Even farmers and gardeners, though wise in ways of plants, have a habit of neglecting the roots. This is quite understandable, however, because most crops are commonly evaluated by the above-ground parts. Beets, carrots and turnips are among the few crops grown primarily for their roots.

In spite of the general lack of appreciation for the importance of plant roots, most efforts to promote top growth are actually directed to the roots of the plants. Fertilization, irrigation and most cultural practices affect the roots first. Exceptions, of course, are plant breeding and the control of plant pests and weeds.

It is remarkable how far or deep plant roots can go in search of nutrients and water. The root system of a single corn plant, for example, may occupy 200 cubic feet of soil. On young corn plants, in the five-leaf stage, 23 roots were counted which, in total, were crowded with 10,000 side roots. If all the roots of a single wild oat plant grown under favorable conditions and excavated 80 days after sprouting were put end to end, they

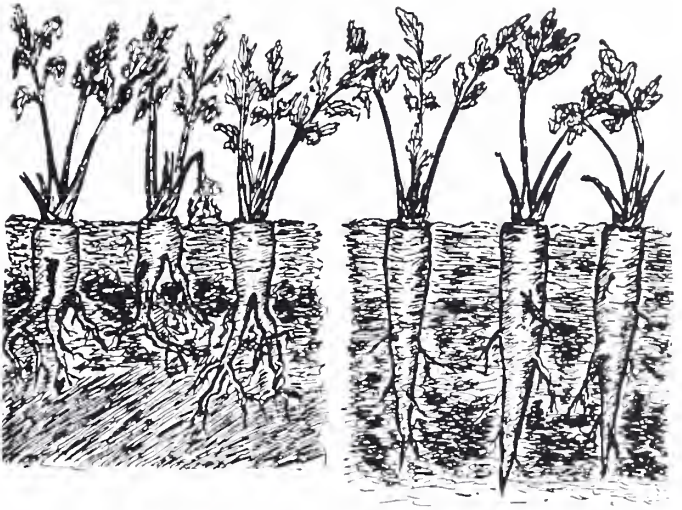


Chard



Potato

In the sketch at left, the soil was not prepared deeply enough, and the manure, left near the surface, caused crooked and branched root growth. Deep soil and thorough mixing of soil and manure are essentials in growing carrots and other root crops.

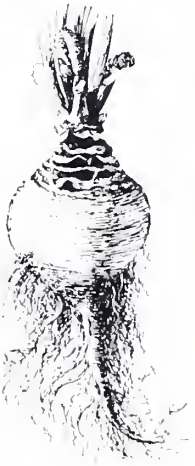


would measure approximately 54 miles.

An ideal soil provides a well distributed system of water reservoirs throughout the soil mass, enough air to permit adequate root respiration and microbiological activity and lots of spaces in the soil into which roots can grow and develop freely.

A "spade test" is one way of getting a look at soil. Dig a narrow pit with a spade and take a thin slice from one of the undisturbed walls. Gently shake this sample and shatter the soil. If it is moist and of good structure, it will come apart in rounded porous "crumbs." A poorly-structured soil or soil layer breaks apart into blocklike clods having flattened surfaces with vertices more or less sharply angular. Cloddy, lumpy soil with extremely fine, almost invisible pores

Turnip



Rutabaga

Leek

within the lump is a pretty sure sign of soil structure deterioration and/or soil compaction. Such a soil is hard to work into a favorable seedbed and becomes waterlogged after every heavy rain.

Soil compaction is caused by pressure on the soil surface, especially when the soil is too wet to work, or to walk or drive on. Careless timing of tillage practices can easily do severe damage to a soil in good physical condition. To cure a bad structure or compaction pan takes a lot of time and effort. In severe cases, the surface soil or the layer of soil at plow or tillage depth may become almost as hard as a concrete floor. Use of a bulldozer can bring about such a condition.

What has been indicated here on the subject of soil-root relationships emphasizes the importance of examining your garden soil. Dig a little deeper than usual, perhaps two feet down, where the soil has a brighter color, and look for differences in color, compaction or soil depth. Judge for yourself whether or not your soil provides the best conditions for the growth of your plants. If you are not sure, consult an expert. Where soil improvement is too difficult and expensive, the alternative is to choose only those plants that can tolerate the soil conditions you have.

SOIL pH

CLYDE E. EVANS

Soil pH is used to indicate the relative acidity (or alkalinity) of a soil. pH is defined as the logarithm of the reciprocal of hydrogen ion activity. What this means is that the amount and type of hydrogen ions in soil water determine how acid the soil is. Ions are charged molecules, either positive or negative. Their charge and quantity affect the rate and outcome of soil chemical reactions. pH compares hydrogen ions (H+) to hydroxyl ions (OH-) in soil water, or the soil solution. When hydrogen or hydroxyl ions are in equal amounts, the pH is said to be neutral. When hydrogens prevail, pH is acid; when hydroxyls are most represented, pH is alkaline (sometimes called basic).

pH runs from zero to fourteen (acid to alkaline), with seven indicating neutral. pH is a logarithmic measure; that is, each increment is ten times as great as the next. pH 4.0 is ten times as acid as pH 5.0 and one hundred times as acid as pH 6.0, for example.

As pH becomes acid or alkaline (and free hydrogen and hydroxyl ions increase or decrease), chemical reactions occur involving hydrogen ions that either restrict or release *other* ions (including plant nutrients) into the soil solution.

Factors Affecting pH

Generally, soils formed under high rainfall conditions are acidic and those

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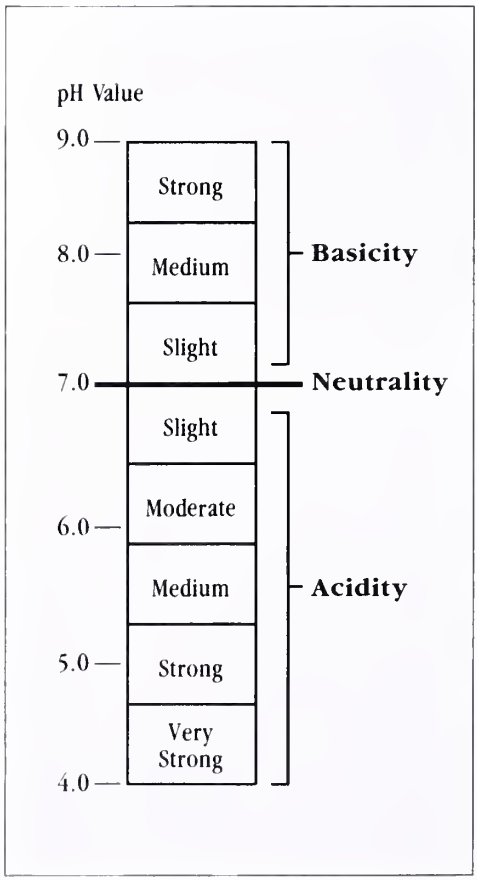
formed under arid conditions are alkaline (or basic). Soils receiving approximately thirty inches or more of annual rainfall are likely to be acidic; soils with less than that are likely to be basic. Because of high annual rainfall, soils of the eastern United States are usually acidic and those of the low-rainfall areas of the western United States are basic.

Fertilizers may be highly influential in soil acidity, depending on the source of their nitrogen. Those containing ammonium (NH_4^+) as a nitrogen source are acidifying. Acidifying substances include ammonium sulfate, ammonium nitrate, urea and ammonium phosphate, and any of these may be found in mixed, complete fertilizers. A complete fertilizer contains all of the three most important plant nutrients: nitrogen, phosphorus and potassium.

Sometimes soils are referred to as "sweet" or "sour." Generally, the term sweet is applied to a nearly neutral or alkaline soil and sour indicates an acid soil. Based on appearance alone, one cannot distinguish the acidity or alkalinity of a soil. Sometimes a soil containing organic matter may have a characteristic odor associated with the breakdown of organic material. Soils having such odors are often termed "sour" or acidic. While it is true that the decomposition of soil organic matter adds to acidity, odors associated with decomposition are not a direct indication of the degree of acidity.

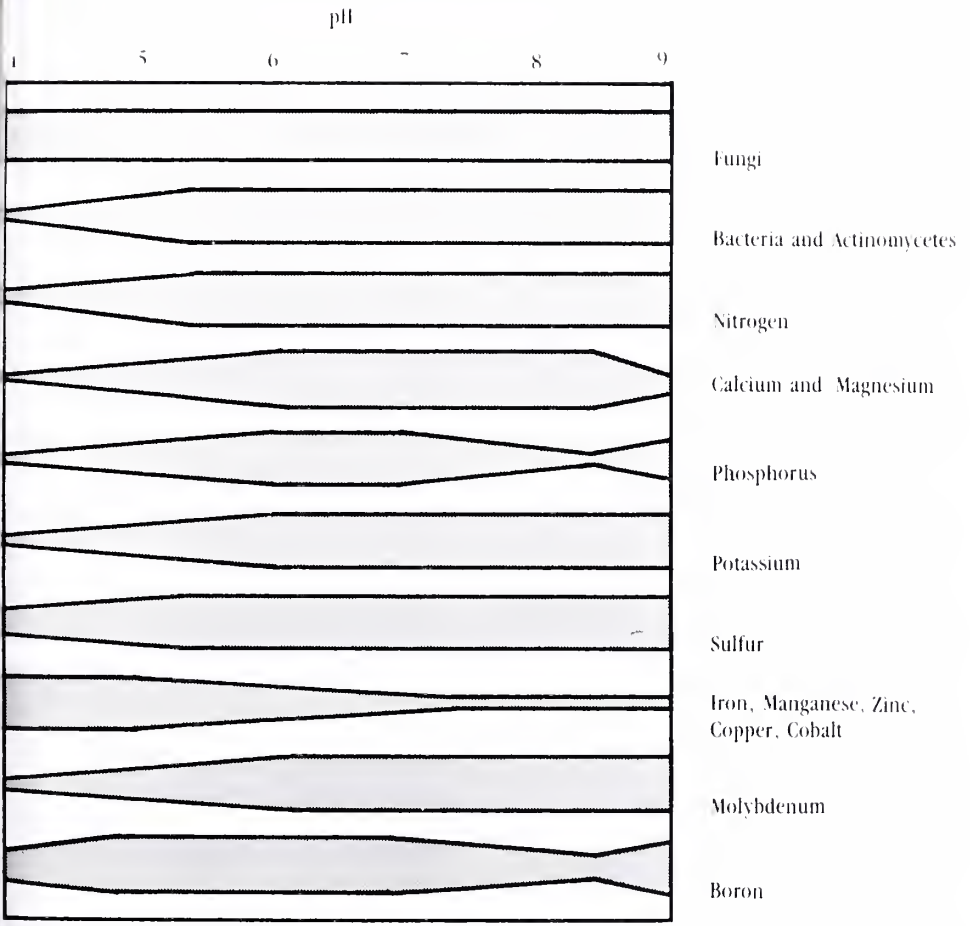


Measuring pH

Two commonly accepted methods of measuring soil pH are indicator dyes and the pH meter. Indicator dyes are the least accurate but are useful in the field for making a rapid pH determination. With experience, this method can be fairly reliable. The more accurate and most-used evaluator, however, is the pH meter. With this device, a suspension of soil and distilled or deionized water is placed in contact with a glass electrode. A reading is then taken from a calibrated scale or digital readout. This is the method used by professional laboratories. Hand-held or portable pH meters are generally too inaccurate to be of any practical use.

Research has determined that most plants grow best in a pH between 6 and 6.8 (slightly acid). Additions of lime and sulfur contribute to chemical reactions that either tie up or release hydrogen or hydroxyl ions, and so affect pH. The change of pH to a level that provides the best mix and quantity of available ions for plant growth (generally between 6

pH Effect on Nutrient Availability and Microorganism Activity



Shaded areas indicate nutrient availability. It is apparent that the majority are most available between a pH of 5.5 and 6.5.

and 6.8) is what is sought by the application of lime or sulfur. Since you must know existing pH before you can accurately change it (or determine if change is necessary), soil testing is important. Because soil make-up varies from area to area, even particle to particle, it is essential that you take many small soil samples and mix them together to obtain an average reading.

THE IMPORTANCE OF SOIL TESTING AND HOW TO DO IT

CLYDE E. EVANS

A lot of time, work and money goes into the establishment and maintenance of fine lawns and gardens. These efforts may be wasted if you lime and/or fertilize the soil improperly. Some plants require different soil acidity conditions than others. For example, azaleas, rhododendrons and gardenias can suffer from iron deficiency if pH is too high. Improper fertilization can cause plant-damaging phosphorous build-up, particularly in sandy soils. It can also cause deficiency problems. So just any fertilizer or fertilization program won't do.

Don't guess at soil lime and fertilizer needs. Many factors such as weather and insects affect plant growth. You can't predict these, but when it comes to a soil's nutrient status, you can take steps to determine current conditions and future fertilizer needs. This is the principle advantage of soil testing.

Don't guess when applying lime and/or fertilizer. There's a better way to manage soil fertility and pH than playing a kind of gardener's Wheel of Fortune. Just take soil samples from your lawn or garden and send them to your state laboratory or to a reputable private testing service. You will receive, in return, a detailed report describing your soil's pH and fertility status and indicating what measures need to be taken to grow the plants you desire.

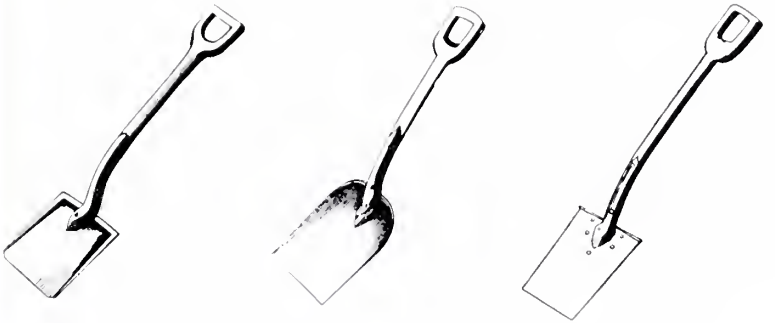
How To Take Soil Samples

Collecting soil samples is not a difficult task, but it must be done properly to get the most meaningful results. Laboratory analyses are precise and accurate for the samples provided. So the better your sample, the better the results of the test. It is your responsibility to make sure the sample adequately represents your yard or garden.

Think of a "soil sample" as meaning the composite of many borings, cores or spade slices from one distinct area. To get a representative soil sample, gather soil from ten to twenty places chosen randomly throughout the area. Then combine and mix these to make a single sample for that location.

Individual samples should represent distinct areas or growing conditions based on present use, past treatment and/or future plans. For example, your yard could be divided into various sampling areas, such as lawns, flower beds, rose gardens, shrub borders and vegetable plots. The front lawn would be one sampling area and the back lawn another, particularly if one area was graded and the other not. Areas that have been limed and fertilized differently in the past should be sampled individually.

Depths of samplings should vary depending on tillage and current condi-



tions. For plantings that are already established and where no tillage is planned, sampling to a depth of two to three inches is preferred. Where tillage is planned or prior to plant establishment, or for areas routinely tilled, take the sample from the tillage depth.

Sampling Tools

Several tools can be used to collect soil samples:

Soil Sampling Tube. This is the most convenient. Simply push the tube to the depth to be sampled. Collect cores from various points and combine them.

Shovel and Tablespoon. Push a shovel six to seven inches deep into the soil. Tilt its handle forward to make an opening wide enough to permit you to scrape some soil from the wall of the hole. With a tablespoon, and starting at the depth to be sampled, scrape upward to the soil surface. Then remove the shovel and let the soil fall back into place. Combine soils from various points for the sample.

Shovel and Trowel. Dig a hole with a shovel, then take a thin slice from one wall. With a trowel, mark off a one-inch-wide strip down the middle of the slice on the shovel and push off the excess on both sides. Combine these one-inch strips for the sample.

For all sampling procedures, use clean tools and containers, mix the samples well, then deposit each combined sample in a soil box or bag for delivery to the laboratory. Most County Extension Service offices have information about sampling, along with boxes or bags for samples and directions for sending them to a testing laboratory.

Home Testing Kits

Do-it-yourself testing kits have been around for several years and are still available. The more inexpensive varieties usually provide only colorimetric (color comparison) tests which are, at best, crude approximations. These may give some indication as to whether or not a nutrient is present, but do not adequately define a soil's relative fertility level. Some of the more expensive kits are more reliable, but their initial cost and the cost for replenishment of chemicals (which must be done yearly) is prohibitive for the occasional testing undertaken by the average homeowner. The fees charged by professional laboratories range from none to a modest rate per sample. And laboratories have the advantage of research information for your particular locale. Therefore, home test kits may be interesting to use, but for more precise evaluation and recommendations, a state or reputable commercial laboratory is best.

Soil Testing Laboratories

of the 50 States and Six Canadian Provinces*

State or Province	Department or Institution Performing Test	Address	Should application be made directly, or through County Agent?
Alabama	Soil Testing Laboratory Auburn University	Auburn University, Alabama 36849	directly
Alaska	Soil Testing Laboratory Agricultural Experiment Station, University of Alaska	533 E. Firewood Palmer, Alaska 99645	County Agent
Arizona	Soil, Water and Plant Tissue Testing Lab, Dept. of Soils, Water & Engineering University of Arizona	Tucson, Arizona 85721	County Agent
Arkansas	Soil Testing & Research Laboratory, University of Arkansas	Fayetteville, Arkansas 72701	County Agent
California	No soil testing service is offered by a public agency.		
Colorado	Soil Testing Laboratory Colorado State University	Fort Collins, Colorado 80523	either
Connecticut	Soil Testing Laboratory Plant Science Department University of Connecticut	Storrs, Connecticut 06268	either
Delaware	Soil Testing Laboratory University of Delaware	Newark, Delaware 19711	County Agent
Florida	Soil Testing Laboratory University of Florida	Gainesville, Florida 32611	County Agent
Georgia	Soil Testing & Plant Analysis Laboratory, University of Georgia	Athens, Georgia 30602	County Agent
Hawaii	Soil Testing Laboratory University of Hawaii	1910 East-West Rd. Honolulu, Hawaii 96822	either
Idaho	Soil Testing Laboratory Dept. of Plant & Soil Science College of Agriculture	Moscow, Idaho 83843	County Agent
Illinois	No soil testing service is offered by a public agency.		

** In addition to those listed here, private laboratories offer soil testing services.*

State or Province	Department or Institution Performing Test	Address	Should application be made directly, or through County Agent?
Indiana	Plant and Soil Analysis Laboratory Agronomy Department Purdue University	West Lafayette, Indiana 47907	either, preferably directly
Iowa	Soil Testing Laboratory Iowa State University	Ames, Iowa 50011	either
Kansas	Soil Testing Laboratory Agronomy Department Kansas State University	Manhattan, Kansas 66506	County Agent
Kentucky	Soil Testing Laboratory University of Kentucky	Lexington, Kentucky 40546	County Agent
Louisiana	Soil Testing Laboratory Department of Agronomy Louisiana State University	Baton Rouge, Louisiana 70803	County Agent
Maine	Soil Testing Laboratory Department of Plant and Soil Sciences University of Maine	Orono, Maine 04469	directly
Maryland	Soil Testing Laboratory Agronomy Department University of Maryland	College Park, Maryland 20742	County Agent
Massachusetts	Soil and Plant Tissue Laboratory University of Massachusetts	240 Beaver Street Waltham, Massachusetts 02254	either
Michigan	Soil Testing Laboratory Michigan State University	East Lansing, Michigan 48824	County Agent
Minnesota	Soil Testing Laboratory University of Minnesota	St. Paul, Minnesota 55108	directly
Mississippi	Soil Testing Laboratory Cooperative Extension Service Mississippi State University	Mississippi State, Mississippi 39762	County Agent
Missouri	Soil Testing Laboratory University of Missouri	Columbia, Missouri 65211	County Agent
Montana	Soil Testing Laboratory Plant and Soil Science Department Montana State University	Bozeman, Montana 59717	either
Nebraska	Soil Testing Laboratory University of Nebraska	Lincoln, Nebraska 68583	County Agent

State or Province	Department or Institution Performing Test	Address	Should application be made directly, or through County Agent?
Nevada	Soil Testing Laboratory Plant Science Department University of Nevada	Reno, Nevada 89507	either
New Hampshire	Analytical Services Laboratory, University of New Hampshire	Durham, New Hampshire 03824	County Agent
New Jersey	Soil Testing Laboratory S & CS Department Rutgers University	New Brunswick, New Jersey 08903	County Agent
New Mexico	Soil & Water Testing Laboratory, Crop & Soil Science Department, New Mexico State University	Las Cruces, New Mexico 88003	either
New York	Soil Testing Laboratory Agronomy Department Cornell University	Ithaca, New York 14853	County Agent
North Carolina	Soil Testing Laboratory Agronomic Division North Carolina Department of Agriculture	Raleigh, North Carolina 27611	either
North Dakota	Soil Testing Laboratory North Dakota State University	Fargo, North Dakota 58105	directly
Ohio	Soil Testing Lab Ohio Res. & Dev. Center Ohio State University	Wooster, Ohio 44691	County Agent
Oklahoma	Soil Testing Laboratory Agronomy Department Oklahoma State University	Stillwater, Oklahoma 74078	County Agent
Oregon	Soil Testing Laboratory Oregon State University	Corvallis, Oregon 97331	directly
Pennsylvania	Soil Testing Laboratory College of Agriculture Pennsylvania State University	University Park, Pennsylvania 16802	County Agent
Rhode Island	Soil Testing Laboratory University of Rhode Island	Kingston, Rhode Island 02881	either
South Carolina	Soil Testing Laboratory Clemson University	Clemson, South Carolina 29634	County Agent
South Dakota	Soil Testing Laboratory South Dakota State University	Brookings, South Dakota 57007	directly

State or Province	Department or Institution Performing Test	Address	Should application be made directly, or through County Agent?
Tennessee	Soil Testing Laboratory University of Tennessee	Nashville, Tennessee 37211	either
Texas	Soil Testing Laboratory Texas A & M University	College Station, Texas 77843	either
Utah	Soil Testing Laboratory Utah State University	Logan, Utah 84322	either
Vermont	Soil Testing Laboratory University of Vermont	Burlington, Vermont 05405	either
Virginia	Soil Testing Laboratory Agronomy Department Virginia Polytechnic Institute	Blacksburg, Virginia 24061	County Agent
Washington	Soil Testing Laboratory Washington State University	Pullman, Washington 99164	either
West Virginia	Soil Testing Laboratory West Virginia University	Morgantown, West Virginia 26506	County Agent
Wisconsin	Soil & Plant Analysis Laboratory, University of Wisconsin	511 Mineral Point Rd. Madison,Wisconsin 53705	either
Wyoming	Soil Testing Laboratory Plant Science Department University of Wyoming	Box 3354 Laramie, Wyoming 82071	either
Alberta	Soil and Feed Testing Laboratory University of Alberta	O.S. Longman Building, 6909 116 Street Edmonton, Alberta	directly
British Columbia	Soil Testing Unit British Columbia Department of Agriculture	1873 Spall Road Kelowna, B.C. V1Y 4R2	directly
Manitoba	Department of Soil Science University of Manitoba	Winnipeg, Manitoba R3T 2N2	either
Nova Scotia	Soils and Crops Branch Nove Scotia Agricultural College	Truro, Nova Scotia B2N 5E3	either
Ontario	Soil Testing Laboratory Department of Land Resource Science, Ontario Agricultural College University of Guelph	Guelph, Ontario	directly
Quebec	Canadian Industries Limited Soil Laboratory Beloeil Works	McMasterville, Quebec	directly

ABOUT LIME AND SULFUR

Changing Soil pH

John Paul Bowles

Lime and sulfur are the two primary soil additives used to alter pH—lime to raise it (make the soil more alkaline or "sweeter") and sulfur to lower it (make soil more acid).

All liming materials contain calcium, but all calcium-containing compounds are not lime. Gypsum, for example, is calcium sulfate. Gypsum is useful for making soils high in sodium fit for growing plants. It also adds calcium to calcium-deficient soils (calcium is an essential plant nutrient), but gypsum does not have much effect on pH.

Liming materials can be divided into two categories: man-made and naturally-occurring. Man-made limes include wood ashes (when the fire is deliberate), blast-furnace slag, hydrated lime and quick lime. Naturally-occurring limes are calcic limestone or calcium carbonate, dolomitic limestone (contains calcium carbonate and magnesium carbonate), ground mollusk shells and marl.

Which lime is best? Liming products are evaluated for their pH changing ability by comparing the effectiveness of each to 100-percent pure calcic limestone—calcic limestone has a calcium carbonate equivalent (CCE) of 100.

Hydrated lime and quick lime are caustic, to you and your plants, and more expensive than limestone. Each has a CCE of over 100, but their disadvantages outweigh their advantages.

Blast-furnace slag is rarely available in a form suitable for horticultural use and may contain undesirable by-products. Wood ashes are fine to use, but vary in liming ability depending on the type of wood burned (fresh wood from hardwood, deciduous tree species produces the best lime). It is interesting to note that wood ashes leached by water become lye.

Marl is a finely particled mineral deposit found at the sites of old, dried-up lakes and on existing lake bottoms. It is okay to use if you can find it. In some parts of the country lime from shells is available, but the shells must be very finely ground to be of any use.

Of the remaining liming products, calcic and dolomitic limestones are the cheapest, easiest, safest to use and the most readily available.

Dolomitic limestone contains about 20 percent magnesium carbonate, so it not only limes soil, but adds magnesium (another essential plant nutrient). Since it's almost impossible to overapply magnesium, it's always acceptable to use dolomitic limestone. In most of the soils of the U.S., however, magnesium is seldom lacking.

Calcic and dolomitic limestones' effectiveness in making soils more alkaline is dependent on the size of their particles. Remember, the two limes are naturally occurring *stones* and must be ground up for use. The smaller the limestone particles, the more rapidly soi

eactions take place and pH change ccurs.

Limestone is seldom pure, however, nd can vary in its CCE. The CCE of use- ul limestone should be at least 80. Happily, modern agricultural and horti- ultural limestone is rarely sold in a form hat has a CCE less than that figure.

How much to apply? That depends on oil type. The finer the texture of a soil, he more lime required to change its pH. Of the three particle components of oil—sand, silt and clay—clay particles re the smallest, sand the largest. Every oil particle has sites where ions can be ttached, detached or exchanged as soil hemical reactions take place. The ttachment of calcium ions to these exchange sites is what affects soil pH. Any equal volume of a clay soil versus that of a sandy soil has many, many more particles and possible reaction sites. Because of this, the clay soil requires much heavier lime applications to be affected toward a pH change.

Also, the difficulty of changing pH increases with an increase in the quantity of organic matter (OM) present. Organic matter is loaded with ion exchange sites. Organic matter, in part because of its high amounts of hydrogen and sulfur, tends to induce lower soil pH. Such things as the percentages of OM and clay in a soil affect the soil's buffering capacity—or its resistance to pH change. This is why it's not a simple "trick" to change pH.

However, many U.S. agricultural soils tend to be clay loams or loamy clays (fine to moderate in texture) with average or low amounts of OM (five percent or less) present in the upper six inches. For home gardens with these kinds of soils, about nine pounds of limestone (CCE=80) are needed to raise the pH one point on the pH scale. You may need to use more if your soil is unusually heavy or high in OM. There *is* one advantage to having heavy or fine-textured soils—because of their high buffer capacities, it is difficult to overapply lime.

The title of this article is "About Lime and Sulfur"—so what about sulfur? Although treatments with other materials besides sulfur will lower pH (many nitrogen fertilizers and some phosphorus fertilizers, for example), elemental sulfur is the best way to reduce pH and acidify soil. Elemental sulfur, sometimes called flowers of sulfur, is just sulfur—nothing else—powdered to make it react quicker. Aluminum sulfate is sold in small quantities as an acidifying agent, and it will lower pH. However, plants are vulnerable to aluminum toxicity and for this reason, aluminum sulfate should not be, or only rarely, used.

Just as for lime, the buffer capacity of a soil determines the effectiveness of sulfur. And sulfur and sulfur-containing acidifying fertilizers, such as ammonium sulfate, usually do not permanently (or rapidly) change pH. So tests and periodic re-applications are required.

Even though a soil test is the most accurate way to find out if sulfur is needed and how much to apply, a general rule of thumb is that two to three pounds of sulfur applied per 100 sq. ft. will lower pH 1.0 unit.

"Why bother with all this pH adjustment business?" you may ask. "After all, wild things seem to do okay." True, but then you don't see English oaks, Japanese hybrid azaleas or potatoes springing up spontaneously in your backyard either (if you do, then you don't need this handbook). The point is, the plants you grow are *not* native to the site you've chosen, and plants *are* pH sensitive. Some are more pH tolerant than others and grow in a wider range, but all have a spot on the pH scale that they like best. Most prefer a range between 5.5 and 6.5, although many are tolerant of levels as high as 7.2 or as low as 5.

Many nutrients become unavailable—or, worse, toxic—when pH is too high or too low. Also, desirable soil fungi and bacteria grow best in a pH between 6 and 7. The addition of lime to some soils improves soil structure by encouraging aggregation of particles, which, in turn, aids drainage and aeration.

Managing pH for specific crops can affect insect and disease control. For example, bluegrass grows well in neutral to alkaline soils, but Japanese beetle larvae *do not.* White potatoes will produce in a pH between 5 and 7, but potato scab *does not* like a pH below 5.5.

By now, I'm sure you'd like to know how to apply the materials. Both sulfur and lime can be surface-applied, but both are more effective and work faster if cultivated in. Neither should be applied to wet foliage and should be watered-in soon after application if in contact with dry foliage. Neither should be applied in windy weather (they are both dusty). Lime should not be applied at the same time as fertilizers. But lime applied long before fertilizer may increase fertilizer uptake. If pH needs to be altered more than one pH unit for soils with existing plants, then apply only enough lime or sulfur each spring or fall to change pH one unit or less until the desired level is achieved. Also, applications of either material may *continue* to affect pH one or many years later, especially if surface-applied.

Soil testing has been mentioned over and over again. If you feel that the recommendations from soil testing laboratories have been too general, then perhaps you have been too general in your submissions. If you are concerned about a specific crop, such as blueberries or azaleas, then send in a separate soil sample from the prospective planting site of each. Or, when submitting a general soil test, provide a list of the specific materials you're planning to plant — deciduous azaleas, apple trees, corn, for example, not flowering shrubs, vegetables and annuals. The soil testing laboratory, however, may not have all the answers, so keep developing that green thumb (and keep a file of pH preferences for your favorite plants) so that one day you'll be able to do the "by-the-seat-of-your-pants" kind of estimating that will make you a real "gardener."

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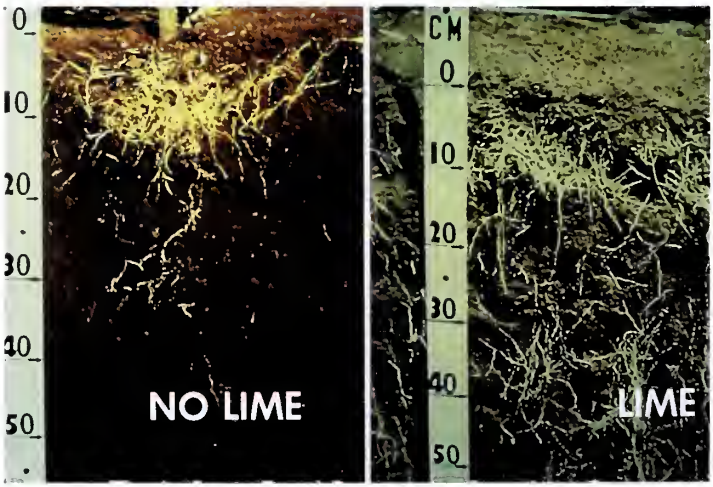

Photo courtesy USDA Soil Conservation Service

Adding lime to soil raises the pH, making it more alkaline or "sweeter." Many nutrients in the soil become unavailable — or worse, toxic — when pH is too high or low.

Suggested Applications of Powdered Sulfur to Lower pH

Figures are for application when combined with cultivation. If applying only to the surface, reduce figures by two-thirds and apply no more often than once a month in warm seasons—less in cold months. For heavy soils, increase recommendations by one-third. Use only powdered or pelleted elemental sulfur, not iron sulfate (at least, not often) and do *not* use aluminum sulfate.

Approximate Lbs. of Sulfur per 100 Sq. Ft. of Soil Tilled to a Depth of 8 In.

Desired ph		4.5		5.0		5.5		6.0		6.5	
Soils		A	B	A	B	A	B	A	B	A	B
	5.0	3/4	2 1/2								
Existing	5.5	1 1/2	4 3/4	3/4	2 1/2						
pH	6.0	2 1/2	6 3/4	1 1/2	4 3/4	3/4	2 1/2				
	6.5	3	9 1/2	2 1/2	6 3/4	1 1/2	4 3/4	3/4	2 1/2		
	7.0	3 1/2	12	3	9 1/2	2 1/2	6 3/4	1 1/2	4 3/4	3/4	2 1/2

A=Sandy Soil B=Loam Soil

General Recommendations for the Amount of Finely Ground Limestone Required to Raise pH

Lime moves downward, but not laterally, in soil. Spread uniformly over the surface. Mix with soil wherever possible to hasten effect. It is preferable to use no more than 50 lbs. of ground limestone per 1,000 sq. ft. per application. If more is required, space applications several weeks apart (depending on rainfall or irrigation).

Pounds of Limestone per 1,000 Sq. Ft. of Lawn Area.

	Existing Soil pH	Sandy Soils	Sandy Loams	Loams & Silt Loams	Clay Loams & Clayey Soils
very	4.0	90	120	165	200
acid	4.5	80	105	150	180
	5.0	70	90	120	150
	5.5	45	60	90	120
	6.0	25	30	45	60
neutral	7				

SOIL CONDITIONERS

NANCY HOWARD AGNEW

When garden soils are inadequate for sustaining vigorous plant growth, soil conditioners may be used to improve tilth. If used properly, conditioners improve the aeration, drainage and friability of tight or heavy garden soils, and the moisture-retaining ability, without water-logging, of light, sandy varieties. Soil conditioners actually modify the structure and texture of soil to achieve these results.

Soil conditioners may be organic (such as peats and composts), mineral (such as sand) or chemical (lime or gypsum). Organic and chemical conditioners function differently, but both help aggregate soil particles and improve physical structure. Mineral conditioners modify soil texture (or the distribution of soil particle size) to improve aeration and drainage.

Organic Conditioners

Organic conditioners are the more versatile of the two kinds. Immediately after application of an organic conditioner, soil becomes more aerated because of the spongy nature of the raw material. The porous organic material also increases soil water-holding capacity. As organic conditioners decompose, a biological glue or cement that binds soil particles together into aggregates is created. The better aggregated the soil particles are, the better the soil's aeration and drainage. Organic materials provide improved plant nutrition because they tend to prevent leaching of soluble fertilizers, and because nutrients are released through bacterial-action decomposition of the conditioners.

Peats

The majority of commercial organic conditioners are comprised of peat. Several kinds of peat can be used as conditioners, but not all of them are suitable for every situation. Peats vary in pH, water-holding capacity and degree of decomposition; these characteristics determine whether or not a peat is appropriate for a particular situation.

SPHAGNUM-MOSS PEAT, a fair soil conditioner, is light brown in color. It has a fast rate of decomposition, which makes it a poor choice if the addition of stabilized organic matter is desired. Sphagnum-moss peat is oligotrophic, meaning it is low in nutrients (only 0.6 to 1.4 percent nitrogen). But it is excellent for use with

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ericaceous (acid-loving) plants because it has a pH range of 3.0 to 4.0. It is also lightweight and has excellent water-holding capabilities.

Hypnum-moss peat, a good soil conditioner, is medium to dark brown in color. Its moderate rate of decomposition makes it fair as a stabilized organic-matter addition. Hypnum-moss peat is eutrophic, meaning it is rich in nutrients (2.0 to 3.5 percent nitrogen), and with a pH range of 5.0 to 7.0, it is a good soil amendment for non-ericaceous plants.

Reed-sedge peat, partially decomposed reeds, sedges, marsh grasses and cattails, is usually a good soil conditioner, but it can be quite variable in pH and degree of decomposition. Low-lime reed-sedge peat has a pH range of 4.0 to 5.0 and contains 1.5 to 3.0 percent nitrogen. Overall, reed-sedge peats have a slow rate of decomposition and are a good source of stabilized organic matter; they have medium water-holding capacity.

Peat humus, dark brown to black in color, is a good soil conditioner. It is highly decomposed and is an excellent source of stabilized organic matter. Peat humus has a pH range of 5.0 to 7.5 and contains 2.0 to 3.5 percent nitrogen. Because of its advanced state of decomposition, peat humus is not spongy and has low water-holding capacity.

Manures and Composts

Green manures (or cover crops) are excellent organic soil conditioners. Green manures, however, take six months to one year to grow. Once mature, they are turned under the soil. Then enough time for decomposition to take place must be allowed before the benefits of soil conditioning can be reaped. Cover crops are less expensive than peat because the cost of seed is comparatively low. Annual rye and buckwheat (sown at a rate of two to three pounds per 1,000 sq. ft.) and rape (sown at a rate of two to five ounces per 1,000 sq. ft.) are all good green-manure crops.

Animal manures can also be soil conditioners. Cow and horse manures are best. Fresh chicken and sheep varieties must be used in small quantities because of plant-burn potential. For this reason, they are not as desirable for soil conditioning. For best results in improving soil texture and adding slow-release nutrients, manure should be composted before use.

Garden compost makes a good soil conditioner. It is inexpensive, but takes time to produce. Its value as a source of nutrients, as a soil amendment for increasing water-holding capacity and as a source of stabilized organic material varies with the stage of decomposition and type of parent material.

Mineral Conditioners

Mineral conditioners improve drainage in tight or heavy soils, such as clay. The primary mineral conditioner used to modify garden soils is sand. It improves drainage by creating larger pores, but the wrong sand or quantity of sand can clog pores instead of enlarging or increasing them, with cementlike soil the result. Usually, additions of stabilized organic matter and perhaps chemical conditioners along with good soil management (don't till when wet, avoid compaction, etc.) are more effective than mineral conditioners for improving heavy soils.

For soil amendment, washed coarse silica sand of the brick or mason type is preferred. Particle diameter should range from 0.25 to 1.0 mm., or the sand should be described as medium- to coarse-textured.

Other mineral conditioners include calcined clay, blast-furnace slag or expanded shale; all should be selected in the particle-size range indicated for coarse sand. Vermiculite and perlite are

not recommended because they lack mechanical strength; they will become crushed in garden soils and will tend to impede rather than enhance drainage.

Chemical Conditioners

Chemical soil conditioners include lime (calcium carbonate) and gypsum (calcium sulfate). These compounds, rich in calcium ions, flocculate (bring together) dispersed soil particles into larger particles. When soil particles are dispersed, water is unable to penetrate, much in the way a drop of water is unable to penetrate talcum powder. Soils high in sodium (sodic soils) tend to be greatly dispersed. These soils are generally located in arid regions and in areas irrigated with water high in sodium. Lime and gypsum flocculate sodic soils by exchanging calcium ions for sodium ions. When soil particles flocculate and form aggregates, aeration and drainage is improved. Chemical conditioners are most effective in soils with this unique condition and are not useful for "loosening" compacted soils or soils with high clay content. In non-sodic soils, lime and gypsum are applied primarily to affect pH or add nutrients.

Cover crops or "green manures," such as rape in the foreground above, are excellent organic soil conditioners.

Leaves are composted in the homemade bins above, providing an excellent source of organic matter and nutrients for the garden.

MANURES AND COMPOSTS

MARY LEWNES ALBRECHT

Earlier generations knew that if you returned to the earth part of what you took from it, it would continue to produce bountiful harvests. Native American Indians taught the pilgrims to place a fish at the bottom of planting holes; they knew that the crop would grow better that way. Farmers use tractors and manure spreaders to return animal wastes to the fields that produced the animals' feed. Home gardeners put such practices to use in flower and vegetable plots.

The incorporation of animal

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Average Nutrient Percentages of Some Manures & Organic Fertilizers

All figures are per 100 pounds

	Nitrogen (N)	Phosphorus (P)	Potassium (K)
Fresh Cow Manure, Including Bedding	.5 lbs.	.3 lbs.	.5 lbs.
Dried Poultry Manure without Litter	4.0 lbs.	3.0 lbs.	3.0 lbs.
Dried Rabbit Manure without Bedding	2.4 lbs.	.6 lbs.	.05 lbs.
Fresh Sheep Manure	1.0 lbs.	.4 lbs.	.2 lbs.
Fresh Horse Manure	.4 lbs.	.2 lbs.	.4 lbs.
Blood Meal	15.0 lbs.	1.3 lbs.	.7 lbs.
Bone Meal	4.0 lbs.	21.0 lbs.	.2 lbs.
Cottonseed Meal	3.2 lbs.	1.3 lbs.	1.2 lbs.
Farrowing Swine Manure	4.0 lbs.	1.0 lbs.	negligible

The composting of fresh manures often lowers their nutrient content because of leaching; however, well managed composting can significantly raise nutrient levels, as initial water-to-solid-material ratio is reduced (fresh manure contains a large amount of water).

manures, composts and green manures into garden soils improves soil structure and workability and adds nutrients. Unfortunately, these organic sources do not supply large quantities of the macronutrients — nitrogen, phosphorus and potassium — that are most essential for plant growth and development. They are, however, good sources of essential micronutrients such as copper, zinc, molybdenum, boron, iron, manganese and chlorine.

Animal Manures

Livestock operations must deal with waste disposal. In feedlots water is used to wash manure from feeding pens. Quite often, this is stored in an effluent pond that is drained on a regular basis, cleaned out and the deposits spread on agricultural land. With stabled animals, bedding is spread to absorb urine and moisture from manure. The used bedding is either spread in fields or stocked in large composting piles. The nutrient content of manure varies considerably depending upon animal species and diet. Feedlot animals tend to produce richer manure than those that are pasture-grazed. Also, pasture-grazed livestock eat "weeds" and, of course, weed seeds. Many native plants found in pasturelands (weeds if in a garden) require a special scarification (the breaking of the seed coat) prior to germination. For many weed seeds, the digestive tracts of grazing livestock provide an excellent scarification treatment. But passed undigested with manure, the seeds, ready to grow, may be added to garden beds. This may also be a problem with the manure of stabled animals which are often pasture-grazed, as well as feed-fed. Proper composting procedures kill most of the weed seeds in manure.

Types of Animal Manure

Poultry manure, commonly available in

Manure? Compost? Green Manure?

hat's the difference between manure, compost and green manure? Manure is he excreted waste of animals; it may be fresh or composted, processed or unpro-cessed, mixed with straw or other material used as animal bedding, or undiluted. Compost is any material that has begun to decompose, and it is usually ready for the garden near the end of its decomposition process. It is often wholly derived from plant residues, but it can contain manure or even *be* manure.

Compost is preferred to fresh material because dead plant parts must decay for nutrients to be released, and the decay process itself uses nutrients. But after a certain point in the decomposition process, nutrients are released and made available for living plants. Also, benefits to soil structure are derived only from decomposed plant residues (if you add undecomposed leaves to a soil, the leaves must decay before they have a beneficial effect). And fresh manures contain chemicals that can be damaging to plants. Green manures are living plants used to improve soil fertility and structure. They also prevent erosion in soils that are not in production.

ags at garden centers, varies considerably according to the type of poultry it originates from—layers versus broilers, or example. Nutrient content is also ffected if the manure has been ydrolyzed (steamed under 30 pounds of ressure for 30 minutes, then passed hrough a drier and finally into a hamer mill) or dried (dehydrated to a oisture content of 10 to 15 percent and assed over a one-quarter-inch sieve). ried poultry waste, which has a greater utritive value than the hydrolyzed variety, has an approximate analysis of 4-3-3, ith less than one percent magnesium nd about nine percent calcium. It also ontains measurable amounts of manganese iron, copper and zinc. Dried oultry manure makes an excellent soil mendment when worked in at the rate f 10 to 20 pounds of manure per 100 quare feet of garden bed.

Swine manure, from farrowing yards, normally mixed with straw bedding. Nutrient analysis is about four percent total nitrogen and one percent phosphorus, with very little potassium. Zinc and iron are also present at trace levels. Wood ashes or muriate of potash (potassium chloride) are possibilities for supplemental potassium. The major drawback of swine bedding as a soil additive is the copper fed to pigs to promote growth and discourage bacteria. The copper is concentrated in the pigs' urine and absorbed in the bedding. If swine manure is used often, copper can accumulate in soils and cause plant toxicity.

Other types of animal manures commonly added to garden soils are cattle, horse and sheep. In *fresh* form, these manures range from about one percent nitrogen for sheep manure to less than one-half percent for that produced by cattle. Phosphate content, at four-tenths of a percent per volume, is highest in sheep manure, and even less for cattle manure. Potassium content for either is

A variety of composting techniques are demonstrated at the Tilth Community Garden in Seattle.

less than one percent. *Dried* cattle and sheep manures have a higher nutritional analysis because of the loss of water and subsequent concentration of nutrients. Nitrogen, though, can be lost due to volatilization, and if compost piles are kept too wet, additional nutrient losses are caused as a result of leaching.

Horse manure is considered to be "hotter" since its nitrogen is more readily available to plants and its nutrient value is short-term. The values of cattle and pig manures are longer lasting, due to a higher content of more slowly available nitrogen. The use of straw or sawdust bedding is desirable because it absorbs much of the moisture from manure and urine and helps prevent nutrient loss.

Use of Manures and Composts

Manures can be handled in two ways: they can be tilled into the ground when fresh, or added to the compost pile t improve it. But fresh manure cannot b safely used around either new or estab lished plants. Commercially dried an bagged manures can be used directly i the garden during spring preparation, even later in the season.

If using fresh manures, till them int the top six or eight inches of the soil i the fall. This allows the manure to brea down into safe forms during the winte If young plants are set into soil that ha had fresh manures incorporated, plan damage can occur as a result of ammon volatilization. Fresh manures should n be used in bulb beds for the same re son. Spread fall applications of fres cattle and horse manures at the rate 50 to 100 pounds per 100 square fee spread fresh sheep manure at the rate 10 to 20 pounds per 100 square feet.

The best manures to use as soil add

Compost can be made in simple heaps, foreground left, bins or drums, and should be worked into the soil on an annual basis.

ives are those that have been composted with sawdust, straw, leaves and/or other plant wastes. Plant residues that make excellent additions to a compost pile include grass clippings, autumn leaves, remains of flower and vegetable plants, weeds that have not gone to seed, peelings and seed pods. Never add disease-or insect-infested material to a compost pile. The addition of dry vegetative matter helps absorb nutrients, preventing their loss. Keeping the manures moist reduces the volatilization losses that normally occur during composting.

An advantage of adding manures to composting plant residues is the additional nutrient compounds they supply. These are necessary for microorganism growth (which is necessary for composting to occur). Thus, the addition of manufactured fertilizers to the compost pile is not necessary if manure is used. But most animal manures have low potassium content. Wood ashes are a rich source of potassium (five to 10 percent by weight). However, because wood ashes weigh so little, considerable amounts must be used.

Tilling manures into the ground improves the structure and workability of soils—better aeration and drainage in heavy clay soils, better "gluing", or particle-clumping action in sandy soils. The latter augments micropore or capillary spacing, making more water available to plants.

Manures or composts must be incorporated as soil amendments on an annual basis. In warm, humid climates organic matter decomposes quickly in the soil and there is little humus accumulation. In drier, cooler climates there may be accumulation, but annual additions are still necessary to improve

problem soils; regular additions of composts or manures contribute micronutrients and help maintain good soil structure.

Composts of animal and vegetable wastes can be used as mulch. A three- to four-inch layer spread over the soil helps prevent moisture loss from evaporation. But in certain parts of the country, organic mulches encourage increased sowbug populations. Normally, sowbugs feed on dead or dying plant tissue. They pose a problem in the garden when their populations increase to the point that they begin feeding on live material. Periodically, the soil under the mulch should be examined for sowbugs. If large populations are present, control measures, such as insecticide application or reduced irrigation (if possible), should be implemented.

Another commonly used organic mulch is uncomposted grass clippings. But in some areas grass clippings ought to be buried in the compost pile for complete decomposition prior to garden use. Fresh grass clippings are a favorite site for stable-fly breeding, a serious problem in rural areas; unlike house flies, stable flies have a nasty bite. Also, fresh grass clippings tend to mat together as they dry, becoming impermeable to water.

Green Manures

Another technique long used to improve soil structure is green manuring. Green manures are special crops that are grown in fields or beds needing improvement. Green-manure plant seeds are generally sown in the fall and turned under in the spring. This operation not only offers the benefit of returning nutrients to the soil and adding organic matter, but the bare ground is protected against wind and water erosion. So green manures also function as cover crops. Green manures are a soil improvement alternative when animal manures are in limited supply.

Green manures are always plants with high water content that decompose rapidly. As green manures break down in soil, there is a release of carbon dioxide and an increase in organic acids which results in temporary acidification, making some unavailable forms of essential nutrients and some micro-nutrients accessible.

Nitrogen is contributed if leguminous cover crops are used. Legumes, such as peas or alfalfa, form symbiotic relationships with certain bacteria species that fix (or acquire) atmospheric nitrogen. The bacteria form nodules (or small swellings) on the roots of the legumes. In these nodules, the bacteria convert atmospheric nitrogen into ammonia which is then utilized by both the bacteria and the plant. When the cover crop is tilled into the ground, a portion of this fixed nitrogen becomes available for subsequent crops.

Common cover crops or green manures include annual rye grass (one to two pounds of seed sown per 1,000 square feet), rye (three to four pounds per 1,000 square feet), oats (two to three pounds per 1,000 square feet) and wheat (three to four pounds per 1,000 square feet). Other non-leguminous green manures include barley, mustard, Sudan grass, millet and buckwheat.

Red clover, alfalfa, sweet clover and cowpeas are used as legume green manures. Check with your local extension office to find out which are winter-hardy in your area. All cover crops should be tilled into the ground early in the spring or prior to seed set.

Regardless of the types of manures or composts available, the time and effort put into them result in more rewarding garden harvests. With the continued use of any manure or compost, soils become lighter, have improved water-holding capacity and aeration and provide a better environment for plant growth.

MAKING "BLACK GOLD"

One Woman's Prize-Winning Method

Marilyn D. Walker

What's dead and alive, good for nothing and useful for everything, worthless and valuable, repulsive and desirable, malodorous and fragrant, wasteful and conserving?—Compost!

Paradoxical as it seems, a person making compost takes "worthless," often malodorous waste and by creating conditions conducive to microbial life, joins with Mother Nature in returning nutrients to the soil.

Ever since green plants began to grow on land there has been death and the recycling of nutrients. Vegetation that dies and falls to the ground nourishes millions of bacteria and fungi, which in their turn die, providing nutrients for plants which evenutally die, etc., etc. If this happens naturally, why go to the trouble of making compost? There are five good reasons:

1) Finished compost is a good substitute for manure. In modern times and crowded places there is not enough manure to use as a soil supplement in food production.

2) Bacteria that decompose dead vegetation require a lot of nitrogen. When vegetation is left to rot on its own, the bacteria seize all the soil nitrogen available and keep that nitrogen from growing plants until the decomposition process is finished. (But, of course, in the end the bacteria die and release the nitrogen to the soil and to plants.)

3) Composting speeds up the natural process to as short a time as fourteen days by some methods.

4) Weed seeds and plant pathogens can be killed by the heat generated by composting if the pile is properly made.

5) If only for the sake of good housekeeping around yard and garden, composting is a worthy endeavor because it takes crop residues, manure and other wastes, and gives back to the earth rich, fragrant "black gold."

Making compost is its own reward. There are many workable methods. Each gardener eventually picks his/her own favored techniques according to location, climate and materials available.

My Own Pile

I have a large — approximately 10,000 square feet — garden in Ohio. Here is my method for making sandwich-layer compost:

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These compost bins are tucked into a corner of a garden in Northern California.

Starting with a five- by five-foot square, I lay down a 10- to 12-inch-deep base (layer one) of twigs, cones or very coarse material, so there is aeration from below. Then I add a 6-inch-deep cover (layer two) of crop residues, weeds and kitchen garbage (no meat scraps or greasy residue).

I keep the layers relatively flat, or slightly concave in the middle, and squared out to the corners. This is essential for water absorption (moisture is vital to composting); the pile should be as wet as a wrung-out sponge, and every layer needs sprinkling before the next is added.

After the second layer is placed and moistened, a two-inch layer of fresh manure is added. The manure is usually already moist and contains straw bedding. Some compost "recipes" call for a layer of soil, but I think there is soil enough on the weed and crop roots. Soil in the compost pile is necessary because it helps keep nitrogen from leaching. The three layers should come to a total thickness of about two feet.

Atop the third layer, I place several two-inch-diameter PVC pipes horizontally. The PVC pipes have one-inch-diameter holes cut in them every few inches to provide aeration to the pile (like water, air is essential). Make sure the pipes are long enough to stick out the sides of the finished heap. The pipes free me from having to turn the pile. (A cubic yard of compost weighs one ton! Who wants to turn that inside out?) Then I continue layering, as above, until the pile reaches four feet or so in height; if the pile were any higher it would be too weighed down, preventing good aeration.

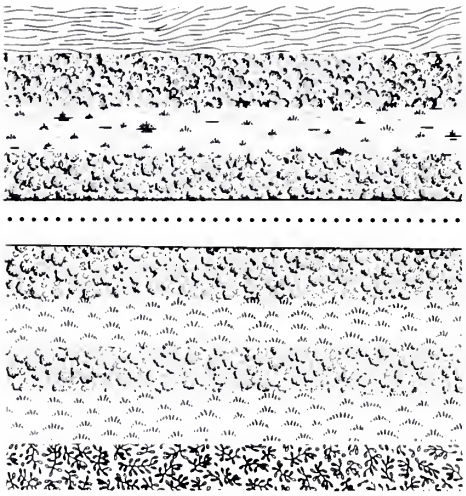
In my region we can have very rainy weather between November and May, so to prevent nutrients from leaching I usually cover the pile with black plastic through the winter. Also, in hot, dry weather a cover prevents loss of moisture. I place carpets over the plastic and sometimes add weighs at the corners to keep them from blowing up. In ar

unsheltered winter location, a windbreak of straw bales is a good idea. Compost made in spring and summer is ready in three months; fall and winter piles are normally ready in the spring.

The principles that my technique follows are:

1) a balanced blend of carbonaceous and nitrogenous materials; the ration is three to one, respectively, or about a six-inch layer to a two-inch layer.

Carbonaceous material, or vegetation containing lots of carbon, is supplied by dry, coarse material: twigs, the straw in the manure and tougher parts of other "stuff" added to the pile. Nitrogenous, or nitrogen-containing, matter is supplied by the manure and soft parts of the plant



materials. In general, the greener, softer or more succulent (water-containing) a plant part is, the more nitrogenous it is, and vice versa.

The desirable carbon/nitrogen (C/N) ratio is based on the quantity of carbon and nitrogen needed by decomposition bacteria (which also just happens to be the ratio of carbon and nitrogen making up the bacteria). Many things commonly added to compost piles—dry leaves and straw, for example—have a very large C/N ratio. The C/N ratio of straw is about 120 to one. Twigs would, of course, have an even greater C/N separation. The C/N ratio needed by decomposition bacteria is closer to 20 or 30 to one, so a compost pile containing only straw decomposes slowly and inefficiently unless additional nitrogen is supplied. However, fibrous material (dry tree leaves as opposed to green lawn clippings) produces more substantial compost.

I've tried making compost without manure, and it did not heat up enough to kill the weeds. High nitrogen additives can also take the form of sprinklings of fish, blood, cottonseed or seaweed meal or even commercial fertilizer. Don't be reluctant to add extra nitrogen to a com post pile—in composting (like so many other gardening activities) you get back as much (more?) as you put in.

2) The provision of good aeration fo the growth and survival of decomposi tion bacteria. Compost piles withou aeration promote anaerobic (function ing without oxygen) bacteria that sme bad, cannot digest organic material com pletely and produce some substance that are toxic to plants.

3) the addition of the right amount moisture required for microbial activit A too-dry pile takes too long to brea down. Note: a foul odor can mean th pile is too wet.

4) The construction of a pile larg enough to "heat up," stay hot and com post. The minimum size seems to be a least three feet square by three feet ta (a cubic yard). Maximum height is abo five feet.

So why not give composting a try You'll find that it is easy, efficient an effective.

MULCH
A COVER STORY

MICHAEL E. ECKER

Mulching was invented by nature eons ago. A forest floor with many thin layers of leaf litter in various stages of decomposition is mulching at its best. Successful mulching is really quite simple and is literally down to earth.

What is mulch? Mulch is any material covering soil. Mulch serves a number of purposes: it controls erosion, conserves water, moderates soil temperature and prevents weed growth; sometimes it's just used for decorative purposes.

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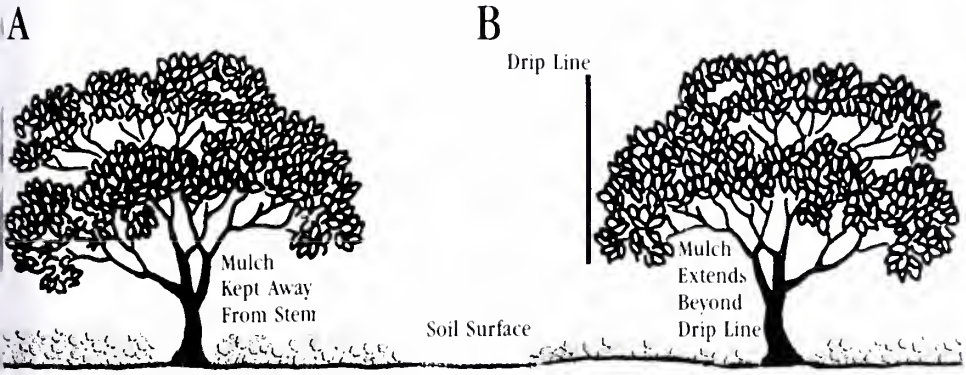
Adding mulch to the soil surface of flower beds, vegetable gardens or under and around trees and shrubs has *many* advantages: soil retains moisture longer (an especially important factor in sandy soils); existing weeds are inhibited from growing and their seeds are kept from sprouting; soil temperature is moderated, keeping soil cooler in summer and warmer in winter; rapid freezing and thawing that can "heave" small plants out of the ground is avoided; mowers are kept a safe distance from plants and mowing is eased by rounding out difficult corners; soil erosion and compaction from rain and foot traffic is



Coarse-textured mulch, such as wood chips or bark (A), can be applied deeper than fine-textured mulch, such as sawdust or grass clippings (B). The more of the root system covered, the more beneficial the mulch.

Mulch controls erosion, conserves water, moderates soil temperature and prevents weed growth — and adds a decorative touch.

prevented; fruits, leaves and flowers stay cleaner (also walks, walls, low windows, etc.) and landscapes are made more attractive, with contrasting areas visually unified.

Organic mulches are materials that were once alive (woodchips, leaves, etc.); inorganic mulches are plastic, stone and the like. Organic mulches have advantages over inorganic; nutrients are recycled and soil structure is improved as decomposition progresses. Also, organic mulches can be worked into the soil if desired, whereas it is necessary to remove inorganic kinds if an area is to be cultivated.

Another reason for adding mulch is to protect against herbicide injury. Some pre-emergent herbicides (which stop the germination of seeds) volatilize readily in warm weather. Unless a protective mulch barrier is placed over a treated area, smaller plants may be injured or killed by the released gasses.

If treating green weeds or grasses with contact herbicides, mulch may be applied first or afterwards; however, slightly better weed control is achieved if the herbicide is applied a few days before the mulch.

There are many types of organic mulch: wood chips, shredded bark, bark chunks, sawdust, sphagnum peat moss, crushed corn cobs, pine needles, grass clippings, peanut hulls, leaves, straw, manure containing straw, newspaper (don't worry about lead—inks no longer contain it), spent hops, cocoa bean and buckwheat hulls, compost, hay; the possibilities are limited only by imagination and accessibility.

The material used should be airy, allowing adequate air circulation for optimum growing conditions (because of

SOIL AERIFICATION BY CORING
What Is It, What Is It Good for?

Compacted or heavy soils have poor water percolation, drainage and air exchange. When an established lawn is growing in such a soil it is desirable to try to improve growing conditions through aerification. This is a process by which small plugs, or cores, are removed from the soil. Coring provides for better air movement in and out of soil, increased water penetration and a decrease in thatch.

Coring is best done in early fall on cool-season lawns and in early summer for warm-season lawns. Cores can be removed in a variety of ways but a motor-driven corer is probably the best. Material removed by coring should be broken up and spread back over the surface of the lawn. Devices that simply make holes in the ground (usually called spike aerators) instead of removing plugs are not recommended.

his, sawdust is not recommended). It hould also be durable, slow to burn, asy to handle and attractive if used rnamentally. Any organic mulch must e replenished occasionally because rganic matter decomposes. Inorganic mulches last indefinitely, but many types eventually disintegrate (paper, plastic), especially if exposed to light.

If fresh sawdust, corn cobs or other fine-textured fresh organic mulches are used, additional nitrogen must be

The more airy a mulch the deeper it can be applied. Wood chips or bark should be applied about two or three inches deep. Six to eight inches of straw or pine needles is recommended.

applied because decomposing bacteria utilize nitrogen that would otherwise be available to plants. For a mulch to decompose, soil microorganisms must feed upon it. These microorganisms require oxygen, water and nitrogen. Plants exhibit stunted growth and a yellow color if, because of competition with decomposition organisms, nitrogen deficiency becomes a problem. When applying fertilizer to correct this situation, use a complete analysis fertilizer with a 1:1:1 ratio, such as a 10:10:10. Pull existing mulch to the side and mix the fertilizer into the top two inches of soil. Mulches decompose more rapidly if they are mixed with fertilizer.

Be cautious when using finely shredded mulches such as peat, sawdust or bark. Once wetted and then dried, the top layer can form a sort of pie crust, impeding water penetration. The development of certain fungi that sometimes grow on mulch, especially chips and shredded bark, can create a water barrier also.

Leaves are a satisfactory mulch because they are widely available, provide trace elements through decomposition and attract earthworms. Leaves present a few problems, though. They have a tendency to blow from where they're placed, and when wet they mat or pack down, which is good for weed inhibition but also inhibits water penetration. The problem can be minimized somewhat by

Mulch Across and Down

Mulching and the Improvement of Compacted Soil for Plant Health and Winter Tolerance

It can (and usually does) get very cold in much of the United States. Even though most of the plants we grow are adapted to winter's chill, many (particularly young, recently transplanted or older plants under stress) benefit from extra protection.

A three- to six-inch-deep layer of *coarse* mulch such as partially rotted leaves, composted grass clippings, woodchips, bark or even straw spread over a plant's root zone can be compared to a heavy down vest that not only keeps the plant warmer by holding the earth's heat, but lessens the possibility of damage from drought and sudden changes in temperature. Mulching not only helps relieve stress in winter, but also helps remedy problems that result from the sun and thirst of summer.

The root zones of established plants extend beyond their drip line, or foliage spread. For young established plants it is advisable to mulch an area one-third to one-half again as large as the area covered by the plant canopy. For older and larger plants at least one-half the canopy-shaded root zone should be mulched. Organic mulch can be spread anytime, but it's best to apply it after temperatures are regularly 45 degrees and lower. Fertilizer, to spur root development and spring growth, can be spread before mulching, at the rate of five pounds of actual nitrogen per 1,000 square feet of soil surface.

Physiological stress caused by compacted, poorly drained and/or drought-subjected soils is common; compacted soil is especially prevalent in urban and suburban landscapes. Many landscape plants such as flowering dog-

hopping the leaves into smaller pieces nd/or mixing with other materials such s grass clippings or pine needles.

Keep thick organic mulches from oming into contact with the bases of rees and shrubs. Rodents working under nulch cover can damage or even kill oung plants. Fungi and slugs that injure lants find a warm, moist, dark area such as under mulch) a haven. If mulch s applied too deeply, overly wet onditions may result. The more airy a nulch is, the deeper it can be applied. For example, when applying wood chips r bark, two to three inches is desirable, whereas a depth of six to eight inches of straw or pine needles is recommended.

If a large area is to be covered and the mulch is delivered via heavy equipment (i.e., heavier than a wheelbarrow), have it dumped near, but not on, the site to avoid compacting the soil. A wheelbarrow may take longer but is far more considerate of soil structure.

Many inorganic or synthetic materials are suitable for more permanent mulches; choices include: black plastic (polyethylene), woven, or fiber weed, mats (polypropylene), aluminum foil or asphalt paper. Crushed stone, or pebbles, is more ornamental but does little to inhibit weeds or retain soil moisture. If used, however, mineral aggregates should be contained by some type of edging, or they will be scattered and lost. Rocks are suitable as an

wood and sugar maple are particularly intolerant of compacted soils.

An aid for this problem has recently been developed. The procedure, known as vertical mulching, is an aerating process that allows air and water to drain into and flow out heavy and compacted soils. To mulch plants vertically, drill holes one or two inches in diameter and 18 inches deep on 12- to 18-inch centers. Position the holes in concentric circles throughout the root zone of the plant subject (remember, roots extend far beyond the drip line). Don't place holes near the plant's trunk—most feeder roots are nearer the drip line, and holes close to the trunk may damage large, supporting roots. Holes one inch in diameter do not need to be filled, but larger holes should be stuffed with a one-to-one mixture of sphagnum peat and fine gravel [coarse sand, calcined clay [e.g., Turface] or shale [e.g., Haydite grade S-1] may be substituted for the gravel). Or you can use one of the coarse mineral materials alone.

If you like, horizontal mulch of a coarse organic material can be applied on the soil surface after vertical mulching, but vertical mulching is effective even in turfgrass-covered areas. Like traditional mulching, this new kind of mulching can be done every year, and should be done several years for severely compacted soils. Timing is not critical; vertical mulch any time the soil is not wet or frozen.

Incidentally, very young and recently transplanted trees should have burlap wrap applied. The burlap should extend from close to the ground up past the first branches. This will reduce rabbit and deer damage and help prevent frost cracks and sunscald.

Organic mulches have advantages over inorganic mulches like plastic and stone: Their nutrients are recycled and soil structure improves as they decompose.

ornamental covering over other permanent mulches, however.

The great disadvantages of using plastic film or any other nonporous mulch is prevention of evaporation and difficulty of irrigation. Plant roots may suffocate beneath the mulch from too much water, or dry up, even in rainy periods. If holes are punched to alleviate these conditions, then weeds become a problem. Also, nothing is more hideous in the landscape than poorly anchored, flapping black plastic.

In vegetable and flower gardens, root growth will be better if mulch is applied in late spring, after soil has warmed up. If planting trees or shrubs in the fall, mulch right away to keep soil around the plants' roots warmer longer, so they continue to grow.

The type of mulch used depends on where an area is located in the landscape. Strawy composted manure, a bit smelly but a good mulch nonetheless, should not (obviously) be used around entranceways or patios. Mulches that are somewhat flammable, such as straw and leaves, should not be applied wherever cigarettes might be tossed. If it's winter mulch protection that's desired, looks should be secondary to function. But deep winter protective mulches (for insulating tender perennials, semi-evergreens and bulbs) that are applied thicker than normally recommended must be removed in the spring, before growth begins.

One further note: you cannot mulch too large an area beneath a tree (at least as far as the tree is concerned). Make the mulched area as extensive as is practical, even past a tree's drip line, if possible. Not only is it good for the tree, but it also means there is less lawn to mow.

HOW TO APPLY WATER

ROBERT N. CARROW

PHOTO BY ELVIN MCDONALD

The amount of water needed for plant growth relies on two major considerations: a) evaporation losses to the atmosphere from moist soil and plant surfaces, and b) transpiration losses. Transpiration is a process that helps plants take up water. During transpiration a plant absorbs soil moisture through its root system and then "transpires" most of it (95 percent or more) through openings (stomata) in the leaves. Untranspired water is retained for plant growth.

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The two water-use components combined are called *evapotranspiration* (ET). ET rates vary tremendously, depending on plant species, air and soil temperatures and amount of wind and sunlight. Two other means of water loss are runoff and leaching below the root system. The goal of good irrigation management is to replace the quantity of water lost by evapotranspiration, while eliminating runoff and leaching losses.

Conditions that stimulate ET, reduce the quantity of ET or lower the amount of water available to a plant's roots (such as low soil water-holding capacity or

TABLE 1
PLANT AND ATMOSPHERIC FACTORS THAT INFLUENCE PLANTS' WATER USE

PLANT

1. *Species* — Species vary in their water requirements. Kentucky bluegrass, for example, requires more irrigation than tall fescues or fine-leaf fescues, while bermuda grass and zoysia use less water than St. Augustine grass.
2. *Rooting Depth* — Good physical and chemical soil conditions will allow maximum root growth for a particular species. Proper management such as fertilization and mowing also promotes good rooting. A deep-rooted plant requires less irrigation.
3. *Stomatal Control* — When a plant wilts, the stomata close and prevent further water loss by transpiration. Unfortunately, the plant will decline in vigor and may die if this stress persists.

ATMOSPHERIC

1. *Temperature* — High temperatures increase plant water use.
2. *Solar Radiation* — Bright, sunny days stimulate evapotranspiration.
3. *Humidity* — Plants grown in arid or semi-arid climates use more water than the same plants grown in a humid climate.
4. *Wind* — Winds up to about four mph increase water requirements but have little influence beyond that rate. However, high winds distort irrigation patterns and prevent uniform applications of water.

shallow rooting) result in the need for frequent irrigation. Some plant and atmospheric factors that influence water use are listed in Table 1. Soil physical conditions also affect irrigation practices and will be discussed later.

To develop a proper irrigation program, you will need to know the answers to the following questions:

How Much Water Should I Apply?

After a rainfall or irrigation, the total quantity of water available to a plant depends on: a) the water-holding capacity of the soil and b) the depth of the plant's root system. Soils differ in their ability to hold water for plant use (see Table 2). For example, a turfgras with a one-foot deep root system growin in a sandy loam soil would have .9 to 1. inches of water available for ET befor drought stress occurs; once irrigation i necessary, between .9 to 1.3 inches o water would have to be added to the soi Thus, knowledge of the soil's wate holding capacity is a guide to how muc must be added to replenish the wate used in evapotranspiration.

A second factor to consider is th depth of the plant's root system. Fo example, a turfgrass with a two-foot dee root system has twice the available wat as a similar plant with a one-foot systen The deeper rooted grass requires *le*

Table 2
Average Water-Holding Capacities and Infiltration Rates for Different Soil Texture Classes

Soil Texture	Plant-Available Water per Foot of Soil* (inches of water)	Infiltration Rate** (inches of water per hour)
Sand	0.4-1.0	.50-8.0
Sandy Loam	0.9-1.3	.40-2.6
Loam	1.3-2.0	.08-1.0
Silt Loam	2.0-2.3	.06-0.8
Clay Loam	1.8-2.1	.04-0.6
Clay	1.8-1.9	.01-0.1

* Soil also holds some water too tightly for plants to extract. The "plant-available water" in this Table is that water potentially available for plant extraction.

** These values vary widely depending on surface conditions (compaction, temperature, etc.).

requent irrigation, but when irrigation s necessary, *more* water is needed to eplenish soil moisture.

Gardeners must evaluate rooting lepths and adjust required irrigation lepths on a seasonal basis for most lants. A dormant plant requires much ess water than it does when actively rowing. Some plants, such as lawn rasses and ornamental perennials, have reater or lesser root development from eason to season, depending on their eriods of active growth.

A good rule of thumb for watering the arden: Irrigate to a level slightly deeper han the plant's root system. To evaluate ow much water to apply, use the nformation in Table 2 at the top of the age; apply the estimated quantity of ater when irrigation is required; check he depth of water penetration after 24 ours; adjust future irrigation quantities ased on how deeply the irrigation eplenished soil moisture. Soil probes hat will help you judge rooting depth nd water penetration are available at garden centers or mail-order houses.

How Often Should I Irrigate?

Standard rules of thumb on frequency of irrigation, such as, "irrigate once per week using one inch of water," are usually not very accurate. Atmospheric and plant conditions affecting water use (see Table 1) vary substantially over the growing season. Thus, frequency of irrigation should be adjusted throughout the season, with more irrigation in the summer.

"Indicator" spots or plants may help in timing irrigations. Most home lawns, for example, have areas of grass that exhibit the first indications of moisture stress, with other areas showing signs one to two days later. By observing indicator spots, gardeners are provided with guides to help schedule the irrigation of specific sites.

Shaded locations often need less frequent irrigation, unless severe root competition from adjacent trees or shrubs is a problem.

Plants often need water during dormant periods. Irrigation may be required during the winter if long periods of above-freezing temperatures occur or if the winter is dry, with little snow cover. This is a significant problem in the Central Plains region.

How Should I Apply Water?

Growers should know how much (i.e., the *rate*) water is applied per hour by their particular irrigation equipment. Rotary systems usually apply 0.25 to 0.45 inch per hour, while spray systems apply 0.75 to 1.0 inch per hour. To check a system, set empty coffee cans every 10 to 15 feet in a grid pattern in the zone watered. After irrigating for one hour, measure the depth of water in each container. Figure the average by adding the depths in all the containers and dividing by the number of containers.

With this information, you can determine how long a site must be irrigated to achieve a desired quantity of water. As an example, if 1.5 inches of water is planned for application to a lawn, and the irrigation equipment used delivers 0.75 inch per hour, two hours of operation would be required.

If the soil has a high percolation of infiltration rate, water can be applied in one setting of a sprinkler. However, many times the soil's infiltration rate (see Table 2) is *less* than the amount the irrigation system delivers. If so, an attempt to apply all the water in one continuous setting will result in excessive runoff. One approach is to apply 50 to 70 percent of the water in one setting, wait for two to 24 hours and then apply the remaining water. This allows the water more time to infiltrate the soil, and eliminates runoff. This method is useful on heavy (high clay content) soils, compacted soils, sloped areas and turfgrasses with excessive thatch. Infiltration rates can often be increased by cultivation or other mechanical methods of aeration.

Besides the rate of water applied, the *uniformity* of an irrigation system is important. When collecting water in coffee cans, you may note that some cans contain very little. This will certainly be evident if you use only one sprinkler at a time to irrigate. Identifying areas that receive too little or too much water helps eliminate dry or wet spots.

In-ground irrigation systems (those buried in the soil) should be designed so they apply water uniformly. If one or two spots receive less water than needed, while remaining areas are adequately irrigated, then those sites must be spot-watered with an end-of-hose sprinkler. Using a water *breaker*, or rose, is the best way to hand irrigate. Do *not* overwater an entire area just to irrigate dry spots adequately.

To achieve uniform irrigation, single sprinklers should be moved about with sufficient overlap. As a rule, reset sprinklers at a distance 50 to 55 percent of the diameter they irrigate (with a wind of greater than four mph, use a 40 to 45 percent spacing). To illustrate, a single sprinkler that covers a circle with a 75-foot diameter should be moved to a new position that's 38 to 41 feet away (assuming low wind conditions).

What Time of Day Should I Irrigate?

The best time to water is very early in the morning when the wind is calm, city water pressure is good, evaporation losses are minimal and leaves remain moist for only a few hours, until the sun dries them (this helps prevent foliage disease).

Another good time to irrigate is in the early evening. Some people are concerned that allowing leaves to remain moist overnight may promote disease. This is not a problem when a site is

rigated all in one evening, or two nsecutive evenings, and then several ys are allowed to pass before the next igation. Under such a regimen, you do not need to worry about disease velopment.

The least efficient time to irrigate is in e afternoon when winds are highest, ter pressure is lowest and evaporation sses are high. Some individuals believe at afternoon watering causes "burning" the leaves because water droplets cus and intensify the light. This is not ue, but if a turf or garden area is erwatered to the point that the soil is turated and standing water is evident and temperatures are very high — the ants can "scald." Under these nditions plant roots will be deprived of e soil oxygen they need to remain ealthy. They won't be able to absorb ater, even when submersed in it, cause of lack of oxygen. And they may e from the subsequent prevention of anspirational cooling.

What Kind of Equipment Should I Use?

nd-of-hose sprinklers are the most mmon home irrigators. These are latively inexpensive but require the bor of having to be moved frequently. he one most often used is the rotary pe that emits water in one or two rections at a time, while slowly rotating. second kind is the sprinkler that emits fan of water, while waving back and rth over an area. A third is the variety at sprays water in a circle in all rections continuously. The last applies ater over a smaller area, but at a high plication rate. All these configurations e available with part-circle or part-wave djustments.

Another system worth considering is -ground piping with quick-couplers. ither rotary or spray sprinklers can be nnected to the couplers. When several sprinklers are employed at one time, this system is more flexible and much easier to use than the single, end-of-hose arrangement.

The most flexible system is the automatic kind in which an electric or mechanical timer activates irrigation of an area by segments (zones). Each zone is controlled by an automatic valve that feeds water to several sprinklers (rotary, spray or wave). When the zone valve is activated by the controller clock, these sprinklers begin irrigation. The clock/timer can be programmed so that a zone is watered at specific times of the day and only on the days indicated.

Automatic systems must be carefully designed so that heads are properly spaced, and, if possible, sprinkler application rates are at or below those of soil infiltration. While an automatic system is the most costly of all, it is a very efficient means of irrigation if properly designed and programmed.

In short, efficient irrigation depends on uniformly applying the correct *quantity* of water at the proper *time* interval and at the appropriate *rate.*

PHOTO BY ELVIN MCDONALD

PLANTS ARE NOT ANIMALS

Understanding Plants' Needs

John Paul Bowles

Nitrogen, along with at least sixteen other elements, is essential for healthy plant growth. Along with nitrogen, hydrogen, oxygen, carbon, phosphorus and potassium are all universally required for life, not just by plants, but by animals too.

For plants, calcium, magnesium, sulfur, iron, boron, manganese, copper, zinc, molybdenum and chlorine complete the essential sixteen. Perhaps you noted that most of these elements are also required by humans, which seems to imply that there is more similarity between plants and animals than is superficially discernible. But there is one (among many) important difference: animals eat, plants do not.

Animals can only receive complete nourishment by breaking down (through digestion) very complex compounds (food) into the simpler forms needed as physiological and anatomical building blocks. Plants, however, can only make use of compounds and elements that are already in a simple form and similar to or exactly the same as the construction material needed for biological growth. Actually, the nutrient bits that plants initially absorb in soil water or air are already simpler than most compounds derived through digestion in animals.

Eating (and breathing, too) is an activity enjoyed only by animals; plants cannot go looking for their equivalent of a hamburger when the need arises. A plant must make do with what is in its immediate vicinity — in the air and water that comes in contact with the leaves, stems, and roots.

For those readers with probing minds who have said, "Wait a minute! What about Venus-flytraps?", consider this: A Venus-flytrap may trap flies as a nutritional supplement, but it doesn't chew, can't swallow or taste, is entirely non-selective (a piece of inert cellophane gets the same treatment as a juicy insect), cannot move on if the "hunting" is poor, and can (and often does) live quite nicely, thank you, with out its bugger snacks if plenty of the right elements are available in adjacent soil water. No, plants do not eat, and the nutrients plants get from air — carbon, hydrogen,

xygen and some nitrogen — are btained through their roots, and drift their vicinity in the same way as all the her nutrients plants absorb.

Notice that in reference to plants, the rds, food and vitamins, have not been ed. That's because the only correct way refer to the sixteen essential elements nd any other elements or compounds quired for plant growth) is plant nutri-nts. It has already been established that ants do not eat, so it follows that they nnot take in food. The word vitamin fers specifically to compounds needed r animal (originally only human) rowth and development. Vitamins eeded for animals may sometimes come om plants, but the application of the ord and the physiological application of ne substance has no parallel in plants.

Fertilizer is sometimes called plant od, even plant vitamins, but now you now this is wrong, right? Fertilizer refers any material put on or in soil to ncourage plant growth. Since fertilizer ust stimulate or improve plant growth, ien it must contain one or more plant utrients. (A material that improves lant growth only by improving soil ructure is a soil conditioner.) Fertilizer omes in several forms: animal manure, ompost or as a pelleted, granular or owdered processed product.

Plants may not eat, but this doesn't ean they are not selective about the utrients they use. Selective is probably ot the best word because I don't mean imply that plants can make choices. hosphorus, for example, is one of the ost common mineral elements in the arth's crust, yet it is a major fertilizer omponent. Why? Because phosphorus n many soils is either insoluble (won't issolve in water) or is in a form that lants cannot use. Plants get the bulk of heir nutrients from water taken in hrough their roots. If soil phosphorus is n an insoluble form, then plants cannot get at it. If the phosphorus in soil water is in a form plants can't absorb, then it just won't be used. Plants cannot change the phosphorus into the kind needed. And phosphorus, like most of the elements required by plants, comes in many forms, as well as parts of other compounds.

Nitrogen is one of the most common elements on earth (air is mostly nitrogen) and, like phosphorus, is a common fertilizer component. Unlike phosphorus, however, nitrogen, although highly transient, can be used in many forms by plants. Nitrogen in soil leaches readily, volatilizes back into the atmosphere or (you've heard this before) is in a form plants can't use.

But people have determined scientifically in recent years — and by trial and error in past ages — that composts and certain ingredients in prepared fertilizers supply nitrogen and phosphorus in forms plants can, and do, use.

So for plants to take up most nutrients, the nutrients must be in forms the plants can use and in soil solution. Soil solution is what soil water is called when referring to its nutrient properties. Soil is vital to plants for three reasons: 1) it provides support for the above-ground parts; 2) it is a source of nutrients, and 3) it is the medium through which the soil solution comes in contact with plant roots. Nutrients get into soil water in various ways: rocks are broken down by weathering (freezing, thawing, erosion); many complex soil chemical reactions take place that dissolve large compounds; rain carries nutrients from the atmosphere; microorganisms, through their particular modes of living (and dying), greatly contribute to the availability of essential nutrients, and we contribute by spreading fertilizer on soil surfaces and setting out the sprinkler.

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PLANT NUTRIENTS

MACRO, MICRO, MAJOR MINOR AND LBS. PER SQ. FT.

JOHN PAUL BOWLES

Plant nutrients are grouped according to the quantity required and the necessity of the nutrient as a result of scarcity. Macronutrients are those that are needed in relatively large amounts. Nitrogen, phosphorus, potassium, calcium, magnesium and sulfur are macronutrients. Because available nitrogen (N), phosphorus (P) and potassium (K) are commonly in short supply in most soils, they are known as major or primary nutrients (the "Big Three" found in most fertilizers). The other macronutrients—calcium, magnesium and sulfur—are called secondary nutrients.

Micronutrients (often referred to as minor elements) are all other nutrients needed for plant growth. These include iron, boron, manganese, copper, zinc, molybdenum and chlorine.

Sometimes in certain soils, secondary nutrients or even micronutrients are in such short supply that they become major nutrients, but this is fairly uncommon. (There are exceptions: iron, for exomple. However, the application of calcium, magnesium or sulfur to affect pH is not considered fertilization because the application is not for nutritive benefits.)

Fertilizer recommendations are usually based on nitrogen supply because nitrogen is typically the most crucial nutrient in shortage. Also, over the years, commercial fertilizers have come to be pronounced in N:P:K ratios that are suitable for most horticultural needs. And the ratios do vary somewhat across the U.S., depending on regional soils and crops. Plant fertilizer requirements or recommendations are usually given in X pounds of nitrogen to be applied to an area. So if recommendations indicate a fertilizer application of 10 lbs. of nitrogen per 1,000 square feet, then the approximate quantities of phosphorus and potassium needed are usually made available, too. This is not only convenient, but correct, since the amount of one nutrient in soil water affects the availability of other nutrients; too much of one nutrient can cause a shortage of another, just because soil-solution balance is off. For example, a complete fertilizer (one that includes all of the big three) with a ratio of, say, 18:5:9, generally supplies the necessary amounts of phosphorus and potassium for the plant group intended (trees and shrubs) if the nitrogen application rate is calculated and used properly.

Happily, manures and composts also tend to supply phosphorus and potassium in agreeable quantities, although a lot more materials must be used. For example, there are, on the average, 10 lbs. of nitrogen, 2.7 lbs. of phosphorus and 7.5 lbs. of potassium per *ton* of dairy cow manure; but in *100 lbs.* of commercial fertilizer 18:5:9 (including base materials—inert matter such as certain types of clays or waxes used as carriers or fillers) there are 18 lbs of nitrogen, 5 lbs. of phosphorus and 9 lbs. of potassium. So 100 lbs. of 18:5:9 has about 36 times more nitrogen than the same amount of cow manure. Of course, as stated in other articles, manures, unlike typical commercial fertilizers, almost always improve soil structure.

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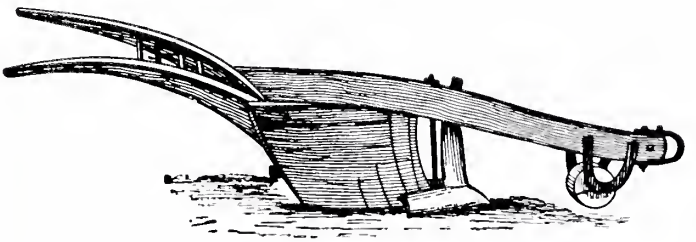
TILLING AND SOIL IMPROVEMENT

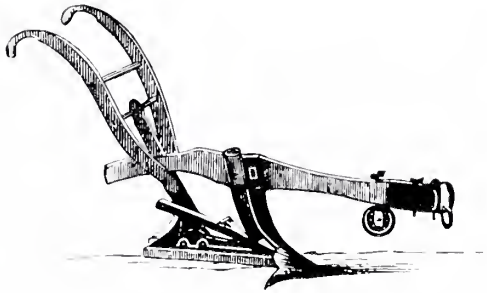
JOHN PAUL BOWLES

Issues that are as hotly debated as politics (and almost as subjective), are how and when to till. These decisions are largely a matter of opinion. You in dig a hole for a plant or plow a garen plot any time or under any rcumstances if you are aware of and illing to accept the consequences. For xample, you might plant in soil that was lled when too wet; almost everybody as (including me). But later in the seaon, because of poor aeration and root rowth in the compacted soil, more irriation will be required.

Wait a minute! Tilling can cause comaction? Of course it can, and an asier-to-visualize example is the case of ıe broken water line. Remember last ear, or the year before, when that pipe ı the back yard leaked and had to be epaired? Isn't there still a sunken spot, ven though the same amount of dirt ent back into the hole as came out? Digging a hole is a kind of tilling. If you till when soil is too wet, it will compact as it settles. Cultivated soil should be friable — moist, but crumbly. Tilling when soil is too wet can cause a condition known as puddling. The soil structure of puddled soil is so disturbed that percolation of water is essentially non-existent.

Okay, I know what you are thinking, and you are right. You *can* begin to correct this kind of compacted soil by tilling again when soil moisture levels are lower. But in central Ohio (where I live) and just about everywhere else, at least in spots, soils are naturally "heavy" (fine textured and clayey) and/or have been so drastically disturbed (or the plants you want to grow need such exceptional conditions) that a good tilling won't help. So it is best to till only when circumstances are just right. Tilling when soil is too wet is not the only way to cause it to become compacted. Overtilling, even when soil is





friable, causes compaction because desirable peds are crushed. Properly tilled soil should be coarse-grainy, not powdery or pulverized.

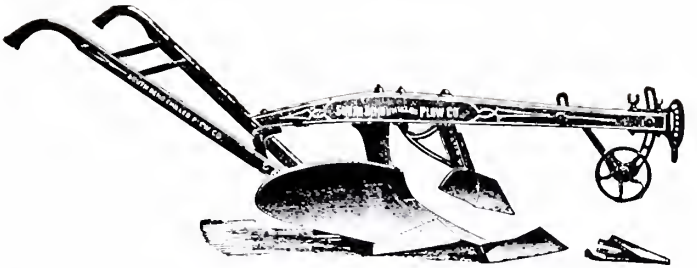
Typical garden cropping whereby plants are grown only for a few months and then mostly or completely removed, causes a reduction in organic matter content. The weight of equipment (even feet) and the force of implements used to cultivate may make a subsurface zone of compaction. The reason many farmers till, plant and fertilize all at once is not just to save time but to cut down on compaction caused by heavy equipment. Your feet crossing the lawn week after week, year after year, behind a mower compacts soil, particularly if you mow after a rain, if the stand of grass is poor (and little organic material is being accumulated in the root zone) or if you collect clippings (which can contribute organic matter to topsoil). Sandy soils are much less prone to compaction than loam or clay soils, but sandy soils usually tend to drain so readily that the addition of organic matter is necessary to increase water retention.

Rotary cultivators often not only pulverize a soil undesirably, but create a compacted zone below the levels tilled. Turning the soil with a spading fork, then raking it smooth is much more conducive to good structure than using a rotary cultivator.

Deep-digging is a procedure that is especially beneficial to the development of soils for finely rooted plants, such as vegetables and perennials. Deep-digging also helps improve drainage in heavy soils and in soils with compacted sub-surface layers, or pans. In deep-digging, the topsoil layer (normally six to 12 inches), is removed and set aside. Then sub-surface soil is spaded up and organic material is incorporated. Topsoil is then replaced and organic matter is incorporated into it, too. For deep-digging to be most effective, the total depth worked should be about two feet for most soils. Deep-digging, assuming it is done when soil moisture levels are low and the soil isn't overcultivated, is effective to a certain extent even if organic matter isn't added.

Tilling is really a way of managing soil so plants can be more easily started, grown and harvested. Another management technique is the addition of organic matter or other materials to improve soil structure, consistency and tilth. With all soils — clay, loam or sand — organic matter additions are the best (often the only) way to improve their physical nature.

Organic matter promotes aggregation of soil separates into peds which allow for increased percolation, drainage and water retention. Organic matter also has a stabilizing effect on pH. Another reliably beneficial soil additive and pH adjuster is lime. But lime is best added only when soil pH is too low (acidic) for good plant growth. It is very difficult to add advantageous quantities of sand to heavy soils. Even if enough were added



a clay soil to make it a sandy clay, ıless pH and organic levels were good, ggregation would remain poor.

Soil organic content is measured by eight. In fine-textured or heavy soils, ,e to 30 percent organic content is con-dered optimum — in coarse soils, two 20 percent. For a clearer understand-g of quantities, compare one pound of eat moss and one pound of clay and ke note of the very large differences in olume. (A soil test can tell you the per-ntage of organic matter in a soil. Be ıre to collect samples as you would for ıy soil test.) Contents of organic matter reater than 20 to 30 percent character-e soils that are called *organic* (versus *ineral*). Although good for plant growth ıitially, organic soils are difficult to sta-ilize because their structure changes as ecomposition occurs.

How is organic matter content main-ıined in mineral soils?

1: Grow plants in an intensive rrangement and disturb as little as pos-ible. Examples: stands of trees and ırubs in a "natural," woodslike setting, ell managed lawns (clippings not emoved). 2: Make surface applications f organic materials to established plant-ıgs. Example: mulching around a shrub order and replacing as needed. Rain-all, soil reactions and soil organisms ıcorporate the organic material into the oil. 3: Apply surface additions of organic ıaterials to necessarily disturbed beds. xample: mulch in a flower border or egetable garden for weed and water control and then incorporating the mulch when preparing the bed for the next planting. 4: Incorporate organic material. Example: spread a layer of compost on a garden and then till.

Which of the last three methods is best? It depends on when, how much and how often organic matter is applied. Fall is a better time than spring for incorporating organic matter because this allows a period of time for soil reactions to occur and for soil structure to improve and stabilize before plants are grown. However, because tilling exposes more soil to air, it causes increased decomposition and lower levels of organic matter. If a garden is cultivated for weed control, organic levels will drop for the same reason: increased exposure to air and heat lead to increased rates of decomposition.

The nature of the garden itself affects organic matter levels; a standard vegetable plot with rows of plants with broad spaces between row has a much lower organic content than an intensely planted plot as the ratio of root mass to soil mass is lower. Cutting at ground level, rather than pulling them up, results in higher organic matter levels.

Just as in a political race, the choice is yours. And as in politics, it is not the informed that make the wrong choices but the uninformed. An informed gardener thinks before he digs, and then digs with conviction.

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MANAGING COMPACTED AND HEAVY (CLAYEY) SOILS

W. Lee Daniels

Soils that are compacted or high in clay resist root, water and air penetration and can seriously hinder plant growth. Compacted soils are very dense and therefore lacking in pore space, which lessens available-water holding capacity and rooting area. Soils high in clay also tend to be dense. Because of the very fine texture and small pore size of clayey soils, water is so tightly held that uptake by plant roots is limited. Due to the lack of large pore spaces, water passes through both soil types very slowly; therefore, both are frequently too wet.

Management of Dense Soils

The ability of a growing root tip to penetrate soil is directly dependent on soil strength. Soil strength is controlled jointly by a soil's bulk density and moisture content. Workable, loose soils have bulk densities of 0.8 to 1.3 grams per cubic centimeter (or have 70 to 50 percent pore space), while severely compacted soils commonly have bulk densities i the range of 1.6 to 1.8 (or 40 to 30 pe cent pore space). Root penetration greatly retarded when bulk densit exceeds 1.4 during dry conditions. Th same soil when moist, however, may n impede rooting because soil strength then decreased.

Bulk density is difficult for the layma to determine accurately so, unfortu nately, analysis of compacted or dens soils must be estimated. You can identi a clay soil (if you can't just by looking it) by measuring its plasticity. To do thi take a small amount of soil from the are or layer in question and wet it. Roll th sample between your palms or on a fl surface. A clay soil makes a long thin ri bon, or string, that doesn't fall apa easily. The longer and more cohesive th "string" is, the more clayey the soil sa ple. Compacted soils or soil layers a (not surprisingly) hard to dig throug whether wet or dry. But a better way determine compaction is to evalua plant root growth. Plant roots will stop be restricted in compacted layers, or ro growth will generally be poor, as co pared to growth in looser soils.

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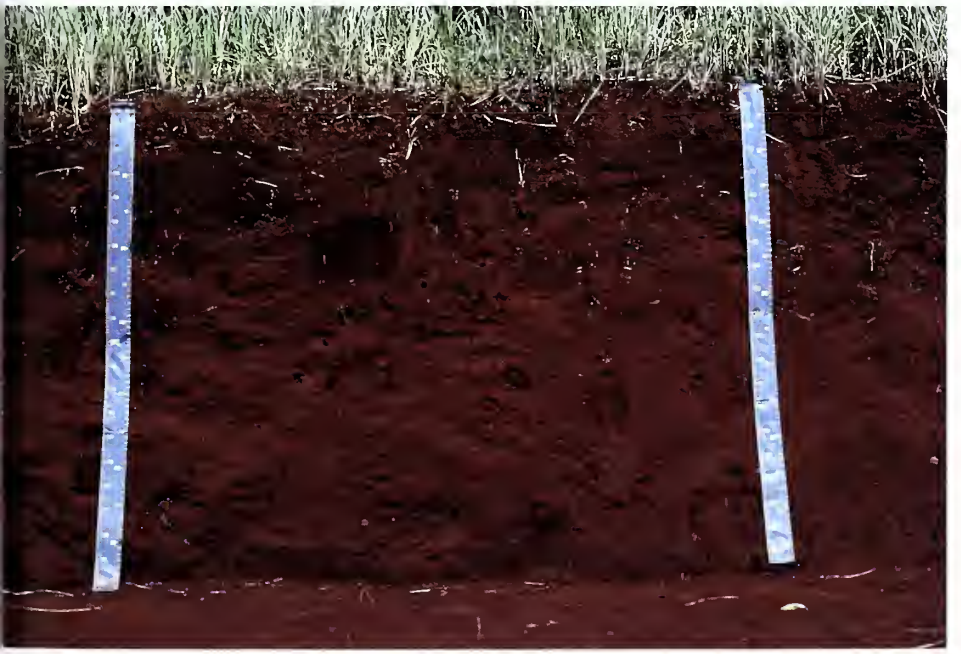
The best way to improve rooting in ompacted soils is to increase the porosty by tillage and through the ncorporation of organic matter into the oil. Addition of compost and/or other rganic amendments into top-soil nsures that soil is well aggregated (or etter structured) and, therefore, conains more large pores, as well as total ore space.

Compacted layers or zones in soils are alled pans. Compacted subsoil layers imit total soil volume available for rootng and restrict total water and nutrient vailability. These layers also perch water ables (cause water to "back up" instead f draining downward). Sometimes, vater tables perched by compacted soil ayers last for extended periods of time. This causes saturation, or waterlogging, vithin the rooting zone. Deep tillage or ripping is the only practical way to improve subsoil porosity, but may be too expensive for many gardening situations. However, care must be taken to avoid excessive tillage, since that may lead to the destruction of large aggregates. Too much tillage also decreases organic matter content by speeding decomposition.

The structure of the compacted soil zone also strongly influences its affect on plant growth. Artificially compacted zones (traffic pans) are often much denser than natural clay pans, and have no breaks or channels, such as are found in naturally occurring pans. Traffic pans must be physically shattered in order for them to allow significant rooting. Natural subsoil clay pans, on the other hand, often have structural planes of weakness that allow roots to penetrate to some extent, even though the layer overall is



Soils that are compacted or high in clay, like the soil above, make it difficult for water, air and plant roots to penetrate and can seriously hinder plant growth.

PHOTO COURTESY USDA SOIL CONSERVATION SERVICE

very dense. Subsoil pans, especially naturally occurring ones, are permanent, frequently quite thick and are very difficult to alter.

Management of Wet Soils

Compacted and/or clayey soils cause numerous watering problems. The most obvious is surface flooding caused by slow water penetration into the ground. When downward water movement is limited by dense or high-clay layers, soil becomes saturated and oxygen (which moves very slowly through water) is kept away from plant roots. If the saturated condition persists, roots will die from oxygen starvation. Highly compacted soils, even when dry, cause the same problem. Extended periods of water saturation also lead to increased availability of heavy metals such as iron and manganese, which in some soils may actually poison plants. Saturated conditions accelerate soil nitrogen losses, particularly in cool climates and seasons.

There are a number of ways to manage saturation problems in soil. One is to increase internal water movement by improving aggregation and pore space. There are several ways to do this: increasing and maintaining organic material levels; changing or keeping pH in the range between 5.5 and 6.5; adding a soil conditioner such as very coarse sand; cultivating only when moisture levels are ideal, and avoiding compaction. But adding organic material is probably the single most effective action you can take.

Another way to increase internal water movement in wet soils is to shatter subsoil pans. If just a few deep passages for water are made down through the soil, large amounts of water will flow through them (assuming the underlying layers will accept the water). Or subsurface drainage can be installed beneath the soil to carry away excess water. This is usually expensive, but may be the only alternative in many situations. Still another approach is to limit the amount of water entering the soil by diverting surface water away from the poorly drained area, or by digging interceptor trenches just uphill from it. Plastic mulch can also be used to decrease total water penetration.

The best way to avoid saturation problems, however, is to learn how to recognize sites and soils that are prone to them. First of all, look at their position in the landscape. Sites that lie low, particularly at the base of long slopes, receive considerable amounts of subsurface water flow, and are almost always wet. Large flat areas with little surface drainage are also likely to have subsurface water problems, regardless of how high or low the large flat areas are. Gently sloping areas are always the best-drained, without being dry. Take care not to alter surface drainage patterns to insure that storm run-off doesn't flood the site. But this is often already a problem on many suburban and urban sites where natural water drainage has been changed by construction. Areas with dense subsoil pans or bedrock perched water should be avoided whenever possible. Home building and other construction activities often result in severe compaction or the exposure of clay subsoil material.

A number of soil properties are indicative of both poor drainage and water saturation; even a novice soil scientist (that's you) can learn to recognize them. Look at the soil horizon, or the way a soil is layered. Both permanent and fluctuating water tables turn soil gray. Solid gray colors down a soil horizon indicate almost permanent saturation. Fluctuating saturation will cause mottled gray within the background soil color. Free-draining soil will have bright brown, yellow or red in their subsoils.

IMPROVING SANDY SOILS

MANAGING SOIL AND WATER IN ARID REGIONS

FRED D. WIDMOYER

Very few garden soils are exactly as we would like them. Some are too sandy, or coarse, in texture. Sandy soils are easy to work wet or dry, and they warm up early in the spring. But they dry out quickly and often do not supply growing plants with sufficient nutrients, particularly nitrogen.

The addition of organic matter helps sandy soil retain moisture and nutrients longer. Many materials can be used to improve the water- and nutrient-holding capacities of sandy soils: sawdust, hay, bark, straw, cornstalks — with or without coarse-composted materials from the garden. If any of these is dry, hard and/or under-decomposed, apply nitrogen-containing fertilizer to help break it down. Work both the plant material and fertilizer into the soil thoroughly, so that they're evenly distributed.

If you use fresh sawdust as a sandy-soil amendment, add three to four lbs. of nitrogen (11 lbs. of ammonium nitrate or 17 lbs. of ammonium sulfate) to each cubic yard of sawdust (300 sq. ft., one inch deep) to prevent nitrogen deficiency. If smaller amounts of organic matter are applied, figure about 3/4 lb. of ammonium sulfate per bushel (32 quarts or eight gallons or 1.25 cubic feet) of material. If you use coarser material than sawdust, apply less nitrogen. Or use composted sawdust or other composted materials; pre-composted organic soil amendments don't require additions of nitrogen.

Watch plant development closely when using large quantities of organic matter. Slow growth, with small, pale-green or yellowish leaves, usually indicates that the plant is deficient in nitrogen and that a nitrogen fertilizer supplement is needed.

Generally, fresh animal manures and sewage sludge are not recommended for arid lands because they tend to increase saline (salty) conditions. However, if adequate irrigation is possible, no permanent plant damage will occur.

Arid Regions

Soil in low rainfall areas are often unfavorably alkaline. Soil pH can be lowered by increasing the amounts of peat moss, sawdust or ground-up bark, along with acidifying fertilizers. These organic materials tend to hold moisture and fertilizers in light-textured soils. Deep watering helps to remove alkaline minerals that may be a problem. However, soil that is only slightly alkaline, or nearly neutral,

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will grow most garden plants.

Gardeners in regions of low rainfall may achieve greater success by the use of raised beds; it is much easier to modify soil in limited areas rather than entire sites. And drainage is improved when beds are built above existing grades. In some cases you can even grow plants requiring very acid soil by this method if beds are heavily amended to adjust pH levels.

Salty Soils

Excess salts occur naturally in most of the arid parts of the West. Salts are mineral compounds that may become so concentrated in soil water that nutrients, and water itself, become unavailable to plants. In some cases the salts occur naturally, or they may come from irrigation water, fertilizers or chemical applications. Water from shallow wells usually has a higher alkaline (mineral-salt) concentration than water from deep wells. Gardeners with salty soils must depend upon heavy leaching (applying great amounts of water periodically, especially before planting) to move salt concentrations to below the root zone. Excellent drainage in such situations is mandatory; otherwise, one can expect inhibited seed germination, stunted growth, leaf scorch, wilting and death of the plant.

Mulches reduce water evaporation from the soil. This in turn reduces the concentration of surface salts that result from the upward movement (capillary action) of the soil solution. Mulches thus prevent salt contamination of plant foliages and stems.

Salt accumulation around seeds is a common problem with furrow-planted crops. Instead of seeding in the furrow trough, plant on furrow shoulders, on sloped beds or in two rows on wide beds separated by furrows, so that the salts are carried below seed levels.

If irrigations of salty soils are too infrequent, salt concentrations may reach dangerously high levels between waterings. It is during the periods of highest concentrations that plant injury occurs. Growth and yield will be better if waterings are frequent. A saline soil cannot be allowed to become as dry between waterings as a non-saline soil.

In borderline soils, gardeners may prefer to select crops that are salt-tolerant. Vegetables with the greatest salt tolerance are beets, kale, asparagus and spinach; those with the least are radishes, celery and green beans. Some ornamental plants highly tolerant of heavy salt concentrations are iceplant, coyote bush, bougainvillea, pampas grass and Natal plum; extremely sensitive plants are abelia, rose, Oregon-grape, photinia, cotoneaster and Chinese holly.

Hardpans and Sodic Soils

Sometimes arid soils form a hardpan of lime that inhibits drainage and reduces oxygen in the root zone and drastically raises pH in the pan area. In small garden plots, drainage can be improved by using raised beds or by drilling holes through the layer. Perforating the pan is essential for permanent plantings; without it, each planting hole becomes a basin that holds water and drowns the plant.

Sodic (high sodium) soils are usually impermeable to water. Sodium in soil can be reduced by growing sordon or by applying gypsum. Sordon is a sorghum-sudangrass hybrid with the ability to remove sodium from the soil. Growing this grass is a more economical method of correcting the problem than applying gypsum. Gypsum reacts with other minerals to make soil more permeable and allow it to leach out sodium. To apply gypsum, incorporate it at the rate of five lbs. per 100 sq. ft. Cultivate thoroughly, then water in well. If drainage is only slightly improved, repeat the process.

HOW TO MANAGE SUBSOIL MATERIAL WHEN IT IS AT THE SURFACE

W. Lee Daniels

Subsoil materials are frequently encountered at the surface of the ground as a result of erosion of the native topsoil or severe soil disturbances associated with earthmoving and construction activities. Unlike topsoil, this material is often quite clayey and dense, devoid of organic matter and resistant to plant growth. Subsoils in humid regions are usually highly leached, acidic and infertile, while subsoils from drier areas tend to be much less acidic, but may be high in shrink-swell clays and/or salts. Subsoils in any region may be rocky.

Making Topsoil Out of Subsoil

Usually, the most important factor to correct immediately is the low organic matter content. Large amounts of compost or other organic materials must be repeatedly mixed in *deeply* (one foot or more, if possible). Over time, the organic matter decomposes and stabilizes the new surface soil, aiding in essential soil particle aggregation and building nutrient supplies.

Next, problems of acidity and infertility must be solved through liming and use of appropriate fertilization strategies. Have pH and fertility tests done and follow recommendations. Remember that the establishment and maintenance of organic matter in the soil does much to aid fertility.

Most subsoils are dense and/or clayey, so particular attention must be paid to the problems of poor drainage and water saturation. Even the addition of trucked-in topsoil usually will not solve poor drainage problems caused by heavy or compacted subsoils. Before new topsoil is added, or created by the addition of organic matter, poorly drained exposed subsoils must be deeply, but coarsely, tilled. In some cases laying tiles below grade to facilitate drainage is advised. In many situations the use of raised beds greatly eases the modification of surface soil properties.

Subsoil materials left by construction and earthmoving are often unnaturally mixed and are variable from point to point. Whenever possible when undertaking soil testing, analyze samples from numerous points, rather than putting all samples together; this allows you to isolate the problem areas that need special attention.

COMPACTED ZONES IN SOIL

W. Lee Daniels

Compacted zones or layers in soil seriously limit root, water and air movement and thereby adversely affect plant growth. Soils become compacted by a number of natural and man-made mechanisms, all of which lead to a reduction in soil porosity and an increase in soil bulk density (bulk density is the mass of a dry soil per volume). Soils with low bulk density are desirable because they have more pore space for water and air movement.

A soil which is heavily compacted will severely limit plant growth even if other physical and chemical characteristics such as texture and pH are optimal. Water percolation down through soils is greatly slowed by compaction (or any sudden or major change in soil texture). A layer of compacted soil may cause droughty conditions if at or near a soil's surface, or water logging if the compacted zone is deeper.

Causes of Compaction

Pan is the word soil scientists use to describe compacted soil zones. Natural soil-forming processes generate a wide variety of compacted subsurface pans in all regions of the U.S. In humid areas rainwater leaches clay particles downward into the subsoil, forming clay pans (known to soil scientists as *argillic horizons*). These clay layers are often dense and stiff, making them difficult to till. In fact, many agricultural soils in the East have experienced enough long-term erosion that the subsurface clay pans are now at or near the surface. Plant roots can penetrate these zones along natural cracks and fissures only if the pans have a well developed structure.

A number of commonly occurring compacted zones are collectively known as *fragipans*, and are characteristically very dense and brittle, with few structural gaps for root penetration. These layers are seldom clayey, but tend to be loamy or silty in texture. In drier regions of the country calcium and sodium salts tend to accumulate in the subsoil and often cement it into a dense, whitish-colored pan. If you are unsure about whether or not your soil contains one of these various pans, seek out and study local soil surveys (available from the Soil Conservation Service — your County Agricultural Extension Agent can direct you to the nearest SCS office).

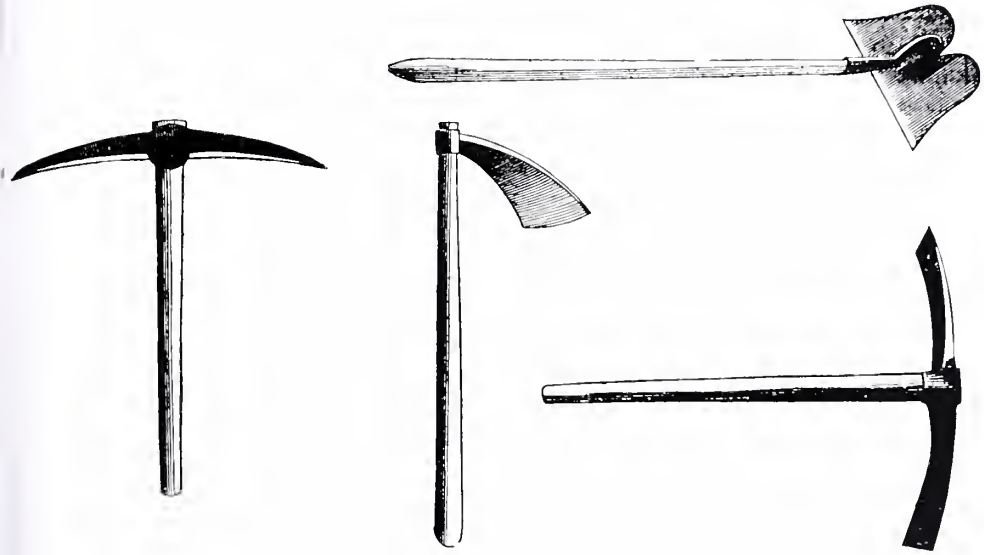
Vehicle traffic, such as associated with construction, can severely compact soils. But normal foot traffic, game playing, even lawn mowing can cause compaction. These compacted zones may occur at the surface or deep in the subsoil, but are often more dense than many natural pans. Artificially induced pans are particularly common where several layers of soil have been disturbed, such as when topsoil is returned to a regraded lawn after house construction, or where cut-and-fill operations have been per-

formed to shape an area for landscaping. Natural soil structure is usually destroyed by these activities; not only are soils made abnormally dense, but there are no longer any natural channels or planes of weakness for roots to penetrate. And naturally occurring pans are, of course, encouraged or compounded by mechanical interference. Soil can even be compacted by rainfall or irrigation, primary causes for the condition known as crusting. Crusting (the formation of a thin layer of surface soil that hardens and resists water penetration) is easily prevented by using a mulch.

Water Impediment Problems

When large amounts of percolating water encounter a compacted zone, or a zone of strongly contrasting soil texture (such as sand over clay or vice versa), water will back up at the contact and saturate the zone above it. Saturated conditions within the rooting zone cause a number of problems for plant growth, including lack of oxygen and potential heavy-metal toxicities.

The nature and quantity of porosity—particularly the amount of large, continuous pores and channels—in soil is the primary factor controlling the rate of water movement. When downward-percolating water encounters a highly compacted zone, it backs up, or "perches," simply because of the major reduction in porosity across the contact. Temporarily perched water tables may persist close to the soil surface from several days to months, depending on local soil and climatic conditions. A similar perching occurs when water passes through a coarse-textured soil layer with many large pores, and then encounters a finer-textured soil layer (even if uncompacted) with much smaller pores. Perching also occurs, but for an altogether different reason, when water passing through a fine-textured layer encounters a coarser sand or gravel stratum. In this case the finer-textured clay soil actually holds onto its water so tightly (due to such forces as capillary action) that it significantly slows its movement into the coarser material below.



No matter what kind of fertilizer you use, read the label carefully and apply it only at the recommended rates. PHOTO BY ELVIN MCDONALD

ALL ABOUT FERTILIZERS

MICHAEL L. AGNEW

A fertilizer is defined as a material applied to soil to supplement plant nutrients already present. Fertilizer additions to soil are used to increase growth or yield, quality and nutritive value of plants. It is important to have a good understanding of different types of fertilizers when developing a fertilizer schedule for lawns and gardens.

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There are at least three numbers printed on the label of a bag of fertilizer. These figures determine the fertilizer grade and are called the *"N P K numbers"*. The first number refers to the minimum

percentage of nitrogen (N) in available form, the second to the minimum percentage of phosphorus (P) as phosphoric acid (P(2)O(5)) and the third to the minimum percentage of potassium (K) as potash (K(2)O). If other nutrients are added into a fertilizer mix, then their minimum percentages are also listed on the bag.

An example of a common fertilizer grade is 10:20:20. A 10:20:20 fertilizer mix has 10 percent N, 20 percent P and 20 percent K guaranteed in any bulk amount. Thus, a 40 pound bag of 10:20:20 contains four pounds of nitrogen, eight pounds of phosphorus and eight pounds of potassium.

Fertilizers are broadly classified as complete, balanced or single-nutrient carriers. A *complete* fertilizer contains all three major nutrients (N, P, K). Examples include 13:13:13, 10:20:10, and 24:4:8. The 13:13:13 formulation is also a *balanced* fertilizer because it contains equal proportions of the three major nutrients. When a fertilizer contains only one of the three major nutrients, it is called a *single-nutrient* carrier. Examples include ammonium sulfate, 21:0:0 (supplies only nitrogen); superphosphate, 0:20:0 (phosphorus); and potassium sulfate, 0:0:50 (potassium).

Selecting a Fertilizer

A factor in the selection of a fertilizer is its acidifying affect. In general, fertilizers that contain the ammonium form of nitrogen produce an acidic reaction, while fertilizers that contain nitrates produce an alkaline reaction. Neither phosphorus nor potassium sources have an important effect on soil pH reaction. Highly acidifying fertilizers should be avoided in regions of the country where basic salts are leached away (i.e., areas with very acid soil); additions of acidifying fertilizers only further increase lime requirements. In areas where the soil pH tends to be alkaline, acidifying fertilizers can help to reduce the pH to a more favorable range. A list of acidifying fertilizers appears in Table 1.

Table 1
Fertilizer Effects on Soil Reaction.

Fertilizer Source	Soil Reaction
Ammonium nitrate	Acidic
Ammonium sulfate	Acidic
Calcium nitrate	Basic
Urea	Acidic
Monoammonium phosphate	Acidic
Potassium nitrate	Basic

Fast Versus Slow Release

The nitrogen fertilizer sour.0ces mentioned up to this point are all *fast-release* or water soluble. While nitrogen in fast-release fertilizers is readily available for plant uptake, its water soluble properties lead to rapid depletion by leaching or volatilization (vaporization into the atmosphere). Also, fast-release fertilizers have a high potential for foliar damage (leaf burn) due to a high salt content of the fertilizer source.

Other nitrogen fertilizers are classified as *slow-release*. These types of slow release nitrogen fertilizers are: natural organics, slowly soluble and coated materials. The release of nutrients from these different materials is primarily due to microbial decomposition, or microbial decomposition in combination with various chemical or physical soil reactions. Nitrogen availability from slow-release fertilizers varies with the time of the year and weather because the activity of soil microorganisms and rate and quantity of soil reaction is dependent on soil temperatures and soil moisture content. The major fast- and slow-release fertilizer sources are listed in Table 2.

Table 2
Characteristics of Fertilizer Sources

Source	Approx. N	Nutrient Percents P_2O_5	K_2O	Burn Potential	Availability Rate
Ammonium nitrate	33	0	0	High	Fast
Ammonium sulfate	21	0	0	High	Fast
Urea	45	0	0	High	Fast
Urea formaldehyde (UF)	38	0	0	Low	Slow
Isobutylidene diurea (IBDU)	31	0	0	Low	Slow
Sulfur coated urea	32	0	0	Low	Slow
Plastic encapsulated	V*	V	V	Low	Slow
Activated sewage sludge	6	4	0	Low	Slow
Bone meal	5	27	0	Low	Slow
Cottonseed meal	7	3	2	Low	Slow
Monoammonium phosphate	11	48	0	High	Fast
Diammonium phosphate	20	50	0	High	Fast
Superphosphate	0	20	0	Low	Medium
Treble superphosphate	0	45	0	Low	Medium
Muriate of potash	0	0	60	High	Fast
Sulfate of potash	0	0	50	Low	Fast
Potassium nitrate	13	0	44	High	Fast

*V = amount varies depending upon use.

Natural organic fertilizer carriers include various sewage sludges and plant and animal residues (composts and composted manures). Nutrient release from natural organics is primarily due to microbial decomposition; therefore, nitrogen availability in cool or dry months is low.

Natural organics have the advantages of low foliar burn potential, little nitrogen loss due to leaching and may contain some micronutrients; but unlike processed fertilizers, nutrient content in proportion to bulk material is usually quite low.

Slowly soluble nitrogen fertilizer carriers include ureaformaldehyde (UF) and isobutylidene diurea (IDBU). While UF reacts similarly to natural organics, IBDU is less temperature dependent, but is dependent on soil water content. Thus, IBDU can be utilized during cool weather provided that the soil moisture level is adequate.

Sulfur-coated urea and plastic-encapsulated nitrogen fertilizers are examples of coated slow-release fertilizers. Coated materials are made by encapsulating a soluble fertilizer carrier in a coating of either sulfur or plastic. Nutrient release occurs following the gradual diffusion of water into the capsules. The release rate of the fertilizer is controlled by the thickness of the coating. The nutrient release of the coated materials is only dependent upon amounts of soil moisture, so coated materials release nutrients uniformly during periods of cool or warm weather as long as moisture levels are uniform.

Forms of Processed Fertilizer

Fertilizers may be mined or manufac-

tured, and are formulated as granular, liquid or spikes. Granular fertilizers are the most common. The physical characteristics of granular fertilizers are set by mechanical screening so that spreadability is easy and accurate. Liquid fertilizers are sold either as liquid concentrates or as dry base materials; either must be diluted or dissolved in water prior to application. Both granular and liquid fertilizers can be used for all types of plants (trees, shrubs, flowers, vegetables, fruits and turfgrasses).

Tree and shrub spikes are examples of fertilizers formulated for special purposes. A major concern about spikes is the high concentration of fertilizer in one spot. There is no guarantee that the tree and shrub roots will be in that one location. In addition, the highly localized concentration of fertilizer may burn a root that grows into the area. For this reason, make sure you use spikes that contain a slow-release source of nitrogen.

Types of Plants and Fertilizers

The grade of fertilizer recommended for a particular plant group varies depending on what the plant or crop is grown for. For example, a turfgrass fertilizer is normally complete, with a ratio of 3:1:2 or 4:1:2, and containing at least 35 percent of the total nitrogen as a slow-release material. This is also a good formulation for most trees and shrubs. In contrast, a vegetable fertilizer varies between leafy crops, root crops and pod or fruit crops. Leafy crops require large amounts of nitrogen, so a 1:1:1 or a 2:1:1 fertilizer ratio is recommended. But a root crop requires more potassium; a 1:1:2 or 1:2:2 fertilizer ratio is best. In the case of fruit-bearing vegetables such as tomatoes or peas, more phosphorus is required, so a 1:2:1 or 1:2:2 is the preferred ratio. This rate is fine for flower gardens as well. For vegetables most nitrogen is supplied by a fast-release source.

SOME PLANT GROWTH FUNCTIONS OF SOIL DERIVED NUTRIENTS

NITROGEN	A constituent of all proteins and nucleic acids (hence all protoplasm).
PHOSPHORUS	Fundamental role in many enzymatic reactions, essential to cell division and the development of meristems (growth points).
POTASSIUM	Important to the synthesis of amino acids and proteins, also necessary for photosynthesis.
CALCIUM	Essential to the growth of meristems, particularly root tips.
MAGNESIUM	A constituent of cholorophyll, necessary for the transport of phosphorus in the plant.
SULFUR	Constituent of many proteins and essential oils.
CHLORINE	(Chlorides) Osmotic pressure regulator and a cation (ion) balancer in cell sap (very rarely deficient).

Note: Many deficiencies in plants are due to a particular species' special needs.

Whether a fast-release or slow-release fertilizer is used depends on plants treated, application schedules and personal preference. Either does the job if applied properly. Care must be taken not to overapply fast-release sources of fertilizer, or fertilizer material is wasted and plants may be damaged. Conversely, slow-release materials should not be underapplied, especially the synthetic and natural organic sources, or plant nutrient deficiencies may occur.

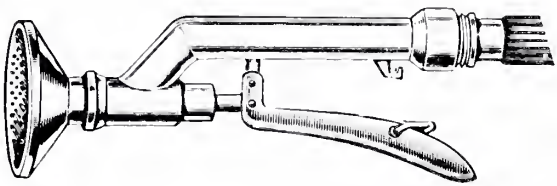
WHAT IS FERTILIZER BURN?

Fertilizer burn is the desiccation (drying out), or necrosis (browning and death), of plant tissue caused by improper or overapplication of fertilizers.

Fertilizer burn is caused in three ways: 1) by the physical contact of concentrated fertilizer particles or very fresh manure with plant parts; 2) by the volatilization (gas formation) of fresh-manure ammonia that may accumulate around growing plants or plant roots; 3) (and this is the most significant) by an overabundance of nutrient ions or salts in the soil. In this case the "burn" is caused by drought: because of the specialized way that plants take up water, if the ion concentration in the soil solution reaches above a certain level, then water can no longer enter plant roots. The concentration of ions in soil water must be less than the concentration of ions in water in the plant.

Fertilizer burn is affected by humidity, amount of soil moisture, rainfall or irrigation, wind and air temperature. Each of the three types of burn is affected differently by these factors.

To avoid fertilizer burn there are reliable rules-of-thumb to follow: never let processed fertilizer particles remain on plant leaves; use fresh manure sparingly or only in composted form and apply fertilizer only at recommended rates (two lbs. or less of nitrogen per 1,000 square feet. per year is a safe rate of application for most plants, soils and situations).



WHAT IS FERTILIZER? WHAT IS COMPOST? IS THERE A DIFFERENCE?

Which is Best?

Fertilizer is any material used to supply nutrients to plants. Compost is any organic material that has mostly or fully decomposed. Decomposition is a process that breaks larger compounds into smaller ones. Since manure should be used only after it is decomposed somewhat, manure you use in your garden is also compost. Fresh manure and just-begun composts are undesirable because they either contain toxic compounds or have not broken down enough to release nutrients in forms plants can use. But in general, composted manure is called just manure—sheep, cow or whatever to indicate its difference from plant-derived or blended (manure and plant parts together) compost. Usually, compost is referred to as a soil conditioner or as a material used to fertilize (i.e., "I'm going to fertilize with compost"), rather than as a "fertilizer."

Processed fertilizer, manufactured or refined products that are sold in bags and boxes, is what is usually thought of or referred to as "fertilizer." Processed fertilizer can also be composted manure or some other compost, but it is usually composed of manufactured ingredients and/or compounds derived from natural sources such as guano (bird droppings) or very pure rock minerals. Processed fertilizer has an enormous advantage over compost because its content is standardized. A farmer or knowledgeable gardener can thereby supply exactly the kind and amount of nutrient needed. Processed fertilizer is also much more concentrated. For example, 50 lbs. of 20:20:20 may equal a ton of cow manure in total quantity of available nitrogen. Although composts and manures vary in nutrient content (because of plants used or eaten), they usually have a nitrogen content, by weight, of between .5 and 10 percent (if figuring application rates for fertilizing purposes, a 2 percent nitrogen content is a safe guess for most composts and composted manures). On the other hand, composts have an advantage over processed fertilizer in that their fiber content helps improve soil structure. Also, unlike processed fertilizer, composts and manures contain essential elements other than nitrogen, phosphorus and potassium. But completely decomposed composts and manures often lose their effectiveness because much, sometimes all, of their useful nutrients are leached away.

Organic has two meanings: 1) any compound containing carbon; 2) any material derived from a living source. The first definition is used when discussing chemicals and biological compounds, the second when referring to the remains or by-products of living things.

The bulk of the nutrients that plants get from soil—nitrogen, potassium, and phosphorus—are inorganic (do not contain carbon). Nutrients are identical whether derived from an organic source (such as manure) or an inorganic source (such as processed fertilizer).

So which is best to use—processed fertilizer or compost/manure? That's a decision for you to make depending on availability of materials, desired soil management, time and funds.

SOME NUTRIENT DEFICIENCY SYMPTOMS

NITROGEN	Small leaves; short, small, thin growth. Uniform yellowing of leaves, becoming red in severe cases. Leaf abscission (removal) occurs beginning with older leaves.
PHOSPHORUS	Bronze to red coloration of dull-green leaves. Shoots short and thin.
POTASSIUM	On older leaves, marginal chlorosis (yellowing) followed by marginal necrosis (death or dead areas).
CALCIUM	Death of the terminal bud, often preceded by chlorosis of the young foliage. Leaves may be distorted, with the tips hooked back. Root system is damaged first, usually with death of the root tips.
MAGNESIUM	Interveinal (between leaf veins) chlorosis on the foliage, followed by interveinal necrosis.
BORON	Distortion or thickening, or both, of the young terminal foliage. Some yellow spots may appear on the foliage. Terminal bud ceases development and lateral growth begins. Lateral growth soon goes through same cycle.
SULFUR	Uniform yellowing of new and young foliage.
IRON	Interveinal cholorosis of the young foliage, followed by bleaching of leaf color to cream or white.
COPPER	Necrosis and white mottling of newer foliage. May result in small, linear, distorted leaves. Shoots die back.
MANGANESE	Yellowing of foliage.
MOLYBDENUM	Leaves do not fully expand; color often bluish-green; chlorosis and necrosis also present.
ZINC	Small, narrow leaves in a rosettelike whorl.

Because nutrient deficiency symptoms of different elements are sometimes similar, because the same nutrient deficiency on different plants may be manifested differently and because some diseases cause similar effects, positive diagnosis of nutrient deficiencies is very difficult. Although with experience some deficiencies, especially those that are nitrogen related, are fairly easy to identify, the best means is through soil tests or plant tissue analysis. Many states offer plant tissue analysis through the State Extension Service.

Nutrients, and other minerals, can be overabundant in soil and cause toxicity. This overabundance can be natural or caused by man (chlorine from pool water is an example). Natural soil toxicities are fairly uncommon, and their symptoms and signs, unfortunately, often resemble mineral deficiencies, diseases or such things as air pollution damage (which of course is a toxicity, too).

TOSS IT OUT OR MEASURE CAREFULLY

A Gardener's Fertilization Dilemma

Fertilization recommendations are much more specific these days than they once were. It used to be that you were simply told to put a handful, or 1/2 cup, at the base of a shrub or scatter fertilizer lightly under a tree's canopy.

But now it seems that a weight scale is more important than a measuring cup. However, the measuring cup is more convenient—so what do you do?

First of all, do not guess. Fertilizers come in a wide range of concentrations and 1/2 cup of one may be just what the doctor ordered, while 1/2 cup of another may send a plant to the coroner. Do learn to figure amounts of nitrogen per 1,000 square feet, and at least the first time you use a product for a specific plant or plant group, do measure it out. After that you can probably safely "guestimate" amounts to be applied.

However, large areas requiring significant amounts of fertilizer such as lawns and vegetable gardens should never be figured "by the seat of your pants."

Fertilization is a tool that helps you grow plants bigger, better and faster. Use it well and you'll get favorable results; use it poorly and you'll waste the product—or the plant.

METHODS OF FERTILIZING

Surface Application, the Best Way

Mary L. Wilmoth

Neither soil injection nor the placement of pills, packets or spikes surpasses broadcast surface application in fertilizing effectiveness. Surface application is the easiest and fastest way to apply fertilizer because little or no equipment is necessary and the labor involved is minimal. And research has shown that in most cases, surface applications for established plants are as effective, or more effective, than subsurface treatments. This is probably due to the localizing effect of drill-hole type procedures, as opposed to the more even coverage of broadcast applications. For proper surface application, spread the recommended amount of fertilizer *uniformly* on the ground under and beyond the branch spread of treated plants.

Recommendations of over three pounds of actual nitrogen per 1,000 sq. ft. per year is too high for a single application around trees that have grass or other plants growing under them. For such situations it is necessary to apply fertilizer in several small applications (with thorough watering after each).

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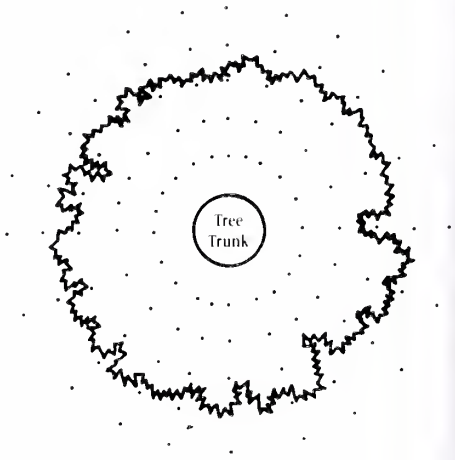
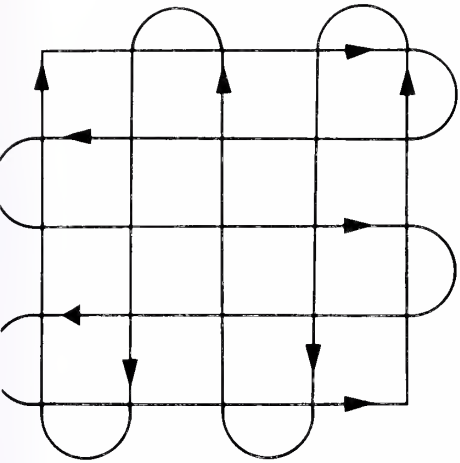


Recommended pattern for subsurface applications of fertilizer: drill-hole or liquid soil-injection methods.

Limited-Use Methods for Homeowners

Liquid Soil Injection. This involves the use of a thin tube pointed and perforated at the end. It is attached to a hose or sprayer, and fertilizer solution is injected through the tube and into the ground at the desired depth. Insert the tube to a depth of six to 12 inches or


This method insures even coverage
First spread ½ or less of total fertilizer product along one axis
Then spread ½ or less along the perpendicular axis
Make sure that there is some overlap between each band of applied fertilizer
Finally spread any that remains evenly over the entire area

RECOMMENDED PATTERN FOR SURFACE APPLICATIONS OF FERTILIZER

pproximately two-foot centers. Liquid oil injection is a relatively rapid means ertilizing below the surface of the soil nd turf roots and irrigating at the same ime. Do-it-yourself devices that attach to hose are not effective for applying fer-ilizer because the amount applied is sually far below recommended levels.

DRILL-HOLE APPLICATION. Punching or rilling holes in the soil and then placing ertilizer in them is a technique that has ne advantage of aerating the soil, as well s feeding the zone below turf roots. It lso permits the addition of organic or ther materials that improve soil condi-ions. This method is especially eneficial if plants are growing in com-acted or poorly aerated soils; the nproved aeration may be as effective as ne fertilizing in stimulating new root rowth. One disadvantage is the amount f labor required to make many holes ecessary for even distribution. A motor-riven auger or a punch bar can be used, although the auger is preferred. Augers can be obtained at tool rental centers. The job is done most easily when the soil is moist but not wet.

Dig holes on 12- to 18-inch centers to a depth of six to 12 inches, beginning two feet from the trunk and extending in concentric circles to a line beyond the edge of the branches. If fertilizer in a hole is within two to three inches of the surface it can either kill grass or stimulate a prominent clump of lush, green growth. Because most fertilizer elements do not move laterally in the soil, the more holes made, the better the distribution throughout the root zone. The recommended amount of fertilizer should be distributed evenly among the holes, using a funnel and a small cup as a measuring device. For best results, fertilizer should be mixed with a carrying or filler material — soil, peat moss or sand — so that it won't be too concentrated. After fertilization, completely refill the holes with soil.

CALCULATING FERTILIZER APPLICATIONS

Application-rate recommendations are usually in pounds of nitrogen (N) per 1,000 sq. ft. (but any area division can be used). Chemical analysis numbers, such as 10 in 10:10:10, refer to pounds of nutrient per *100 pounds* of fertilizer. The first number of the three *always* represents nitrogen.

1. To figure the number of pounds of fertilizer that supply one pound of nitrogen:
   EXAMPLE: For a fertilizer rated 10:10:10 (lbs. of nutrients per 100 lbs. of product), divide 100 by 10 (100/10 = 10), or 10 lbs. of fertilizer product contain one pound of nitrogen.

2. To figure the number of pounds of fertilizer that equals other than one pound of actual nitrogen:
   Figure for one pound of actual nitrogen, then multiply answer by number of pounds desired. Example: Recommendations call for two pounds of actual nitrogen and you want to use 18:5:9. Remember, the figure "18" refers to the pounds of nitrogen per 100 lbs. of total fertilizer. Divide 100 by 18 and multiply the answer by two (100/18 = 5.55 x 2 = 11.1). Or 11.1 lbs. of fertilizer contains two pounds of actual nitrogen.

3. To figure the amount of fertilizer to apply for areas greater or smaller than 1,000 sq. ft.:

   a) Figure the number of square feet and then the number of pounds of nitrogen. Example: A 135-by 70-ft. lawn = 9,450 sq. ft. 9,450 sq. ft. = 9,450 increments of 1,000 sq. ft. If 1.5 lbs. of nitrogen per 1,000 sq. ft. is recommended, then 9.450 x 1.5 = 14.175 lbs. of nitrogen is needed to apply 1.5 lbs. of nitrogen/1,000 sq. ft. to 9,450 sq. ft.

   b) Figure the number of pounds of fertilizer that equals one pound of nitrogen (see No. 1). Example: If fertilizer used is 24:8:12, then 100 divided by 24 = 4.17 lbs. contains one pound of nitrogen.

   c) Figure the total number of pounds of fertilizer product required. Example: The pounds (rounded off) of nitrogen needed to meet recommendations (14.18) is multiplied by 4.17 (the pounds of fertilizer containing one pound of nitrogen) to get, approximately, 59 (which equals the pounds of fertilizer to be spread over a 135- by 70-ft. lawn to achieve an application rate of 1.5 lbs. of actual nitrogen per 1,000 sq. ft.).

LEAD IN SOILS

DAVID C. MARTENS AND GROVER G. PAYNE

Because of its physical and chemical properties, as well as its relative abundance, lead (Pb) has been an important metal in human society for thousands of years. Currently, more than 2.5 million tons of lead are produced each year from mined ores. This lead is used in the manufacture of a number of common products including storage batteries, gasoline and paints. But lead poses a potential health hazard to living organisms. The accumulation of lead in the environment has been the subject of increasing concern in recent years.

Lead occurs naturally in all soils, with levels in unpolluted soils generally ranging from two to 200 ppm depending on the nature of the soil's parent material. Additional lead-containing substances are commonly introduced into the environment from a variety of sources. The most common include automobile exhaust, industrial emissions from smelting and refining operations, and the use of sewage sludges as soil amendments.

Exhaust from automobiles is thought to be the primary source of lead pollution in urban areas. Many studies have shown that elevated levels of lead exist in the soil and plants adjacent to highways. Concentrations depend on the traffic volume in the area and the distance from the road. Soil lead content in many major metropolitan areas of thee United States is reported to be several times higher than in rural areas due to the accumulation of lead from automobile emissions. But in most cases soil lead concentration decreases rapidly with distance from the roadway. This fact should be taken into account when choosing a garden site.

Increasing amounts of lead-rich municipal waste materials are being applied to soils as amendments or as sources of plant nutrients.

Repeated applications of these materials can cause substantial increases in the

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lead content of soils, eventually reaching levels that are harmful to animals *and* plants if proper precautions are not taken. Even when lead concentrations are not high enough to be toxic to plants, they may be to us if the plants are food crops. We must *never* raise edible plant materials in lead-contaminated soil.

Emissions from lead smelting or refining operations are generally considered localized phenomena, but they can cause severe problems in the environment immediately surrounding the source of emission.

Another location where elevated lead levels are often found is in the soil around houses (particularly older ones) that have been painted with lead-based paints. This source of environmental lead contamination is not generally considered as serious as others described, except in cases where paint chips are ingested directly by humans or animals.

Once in the soil, lead is relatively immobile and unavailable for plant absorption because it bonds strongly to various soil components. Lead forms very stable insoluble compounds with phosphorus and humic (organic) substances in the soil and becomes strongly held by clay and oxide minerals. Another important factor in controlling the availability of lead is the pH of the soil. At high soil pH levels, lead forms insoluble hydroxide compounds which are not taken up by plants. As the soil becomes more acidic the solubility of these compounds increases and more lead is available for plant uptake. Therefore, to minimize plant absorption of lead from contaminated soils, it is essential that the pH of the soil be maintained at 6.5 or above. Further steps that can be taken include maintaining generous organic matter contact and phosphorus fertility status in the soil.

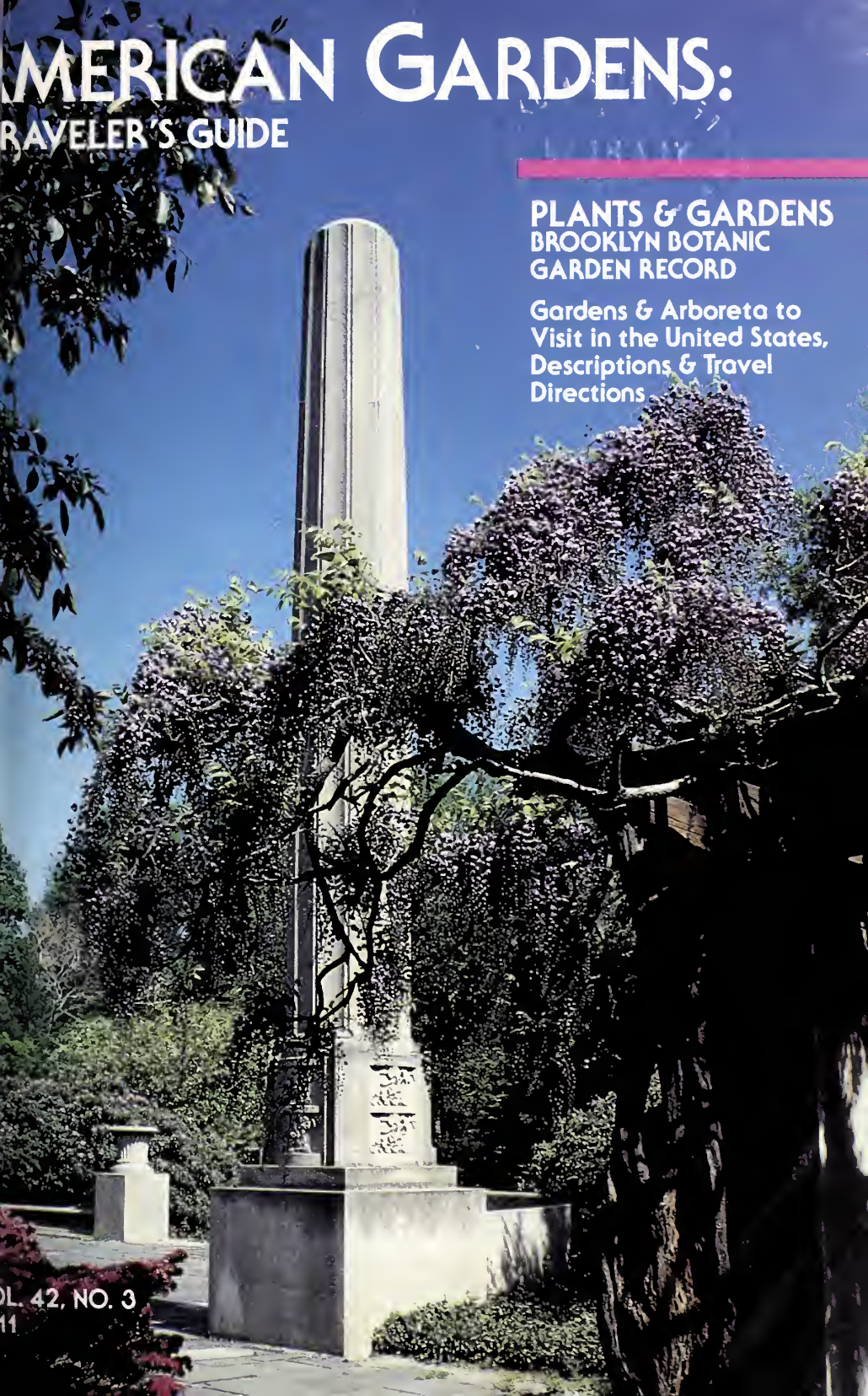
Soil concentrations of lead must reach relatively high levels before the amount taken up by plants is increased significantly and detrimental effects to the plant are observed. Most plants accumulate lead in their root systems, with only limited amounts being translocated to the above-ground portions of the plant. The part of the plant harvested is then an important consideration in selecting the types of plants grown in lead-contaminated soils.

Because of the immobility of lead in soil and in the roots of plants, the major portion of lead found in the aerial parts of plants is thought to come from direct contamination of the foliage by air-borne lead substances. Since most air-borne lead pollutants settle to the ground within short distances from where emissions originate, it is advisable to locate gardens as far away as possible from potential sources of contamination.

If you suspect high levels of lead in soil around your home or in your garden, take a soil sample and send it off for testing; be sure to indicate that you want the sample analyzed for lead content.

Photo by Elvin McDonald

Practical handbooks to share the Brooklyn Botanic Garden's 76 years of excellence in horticulture, education and community service.



MERICAN GARDENS:
RAVELER'S GUIDE

PLANTS & GARDENS
BROOKLYN BOTANIC GARDEN RECORD

Gardens & Arboreta to Visit in the United States, Descriptions & Travel Directions

OL. 42, NO. 3
11

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BROOKLYN BOTANIC GARDEN RECORD

American Gardens:
A Traveler's Guide

1986

Brooklyn Botanic Garden

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About the Guest Editor

Claire E. Sawyers has traveled from coast to coast visiting public gardens in the United States. She holds masters' degrees in horticulture from Purdue University and the University of Delaware where she was a Fellow in the Longwood Graduate Program. She has also worked at gardens in Belgium, France and Japan, and has published many magazine articles on horticultural topics and is employed at Mt. Cuba Center in Greenville, DE. She was guest editor of Plants & Gardens *handbook* Japanese Gardens *in 1985.*

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This handbook would not have been possible without the cooperation and response o each of the gardens included. Special thanks go to the staffs of each of these gardens fo answering questionnaires and generously providing information brochures and photographs

Claire Sawyer

Letter from the Brooklyn Botanic Garden

The first American Gardens—A Traveler's Guide *in the* Plants & Gardens *handbook series was published in October 1970. It remained in print for many years until it finally became outdated. Since that time there have been many requests for a new edition.*

Our guest editor, Claire E. Sawyers, researched the following information for her thesis for the Longwood Graduate Program (see preceding page). From that material our editorial committee selected the botanic gardens and arboreta to be included in this handbook. Space restrictions prevented the inclusion of all *America's public gardens, since that number has been escalating rapidly in recent years. In addition gardens in Canada could not be included because of space constraints.*

Each garden has its season for spectacular displays. For example, the highest visitation period at BBG is in late April or early May when the Kwanzan cherries transform the esplanade into a land of pink enchantment. However, at any season there will be points of interest. Even in winter, gardens located in northern climes have much to offer—characteristics of trees and shrubs that are obscured by leaves become apparent in this season. Fall in many parts of the country produces an extravagance of color in leaves, fruits and berries. And spring—whenever it occurs—bursts forth with bulbs and blossoms. Regardless of the season each garden presents its own special visual pleasures.

No matter when you plan your visit to a garden we hope this handbook will make the trip easier and more enjoyable.

Wherever you travel—enjoy!

Barbara B. Pesch
Editor

How to use this handbook

Some 250 gardens are described in this handbook, and while they range from cemeteries to botanical gardens, municipal parks to historic gardens, they are all open to the public on a regular basis and they all feature horticultural display gardens.

The gardens are organized by state, with the states listed alphabetically for easy reference. Within each state, gardens are listed alphabetically by city, then by name. If you know a garden's name but don't know its location, refer to the Index.

At the start of each entry, basic visitor information is outlined: the hours the garden is open, whether or not an admission fee is charged, directions to the garden and information about public transportation. Admission fees range from a voluntary donation to the cost of a dinner at a moderately priced restaurant. Since these fees may change on an annual basis, the exact amounts currently charged have not been included. Call the garden if you'd like to know its admission-payment policy.

At the close of each description, the services available to visitors are listed according to the following symbols:

–Brochures and/or self-guiding pamphlets are available.

–Car parking space is available in the garden proper.

–Handicapped visitors can be accommodated by the walkways in at least a part of the garden, if not all.

–Labels appear on at least some, if not all, plants.

–Picnic facilities are available.

–Restaurant or snack bar is on the premises.

–A gift shop is included in the garden.

–Guided tours are available. In most cases these must be arranged in advance. In some instances guided tours are restricted to groups. Call for details.

–A visitor, orientation or education center is open to the public and provides displays or interpretive information about the garden.

Additional services provided by various gardens include membership, plant sales, educational events and motor or tram tours.

Bok Tower Gardens, Lakes Wales, Florida

Alabama

Donald E. Davis Arboretum

Auburn University **(205) 826-5755**
Auburn, AL 36830

Hours: every day sunrise-sunset.
Admission: no fee.
Directions: 50 mi. east of Montgomery, I-85 to U.S. 29 north (toward Auburn); 4 mi. from I-85 at the intersection of U.S. 29 and Garden Dr.

The Davis Arboretum is a 14-acre site planted with over 200 different kinds of plants, mostly trees native to Alabama. The site is used for university studies and conservation.

A vinery of native climbers and plant collections indigenous to sand, alkaline Black Belt prairie, coastal bog and swamp habitats are featured.

The Arboretum was established in 1963.

Birmingham Botanical Garden

2612 Lane Park Road **(205) 879-1227**
Birmingham, AL 35223

Hours: every day sunrise-sunset.
Admission: no fee.
Directions: 2612 Lane Park Rd., 2 blocks from Mountain Brook Village; just off Hwy. 280 and the Red Mountain Expwy.
Public Transportation: accessible by transit system.

The Birmingham Botanical Garden, a municipally owned facility administered by the Birmingham Park and Recreation Board, was established in 1962. The 67½-acre garden, supported by 19 clubs and societies, displays over 1,500 kinds of plants.

The formal Rose Garden is made up of 2,000 individual specimens. Iris and daylily gardens contain award-winning varieties. The Wildflower Garden, in a former rock quarry, features Alabama wildflowers. Hybrid and native azaleas can be found in the Rhododendron Garden. Worldwide representatives of hardy ferns and their close relatives grow in the Fern Glade. Crape myrtle, the official flower of Birmingham, is featured in one area, while magnolias dominate another. The Garden for Southern Living shows how to revitalize older plantings by integrating them into a new design. The Vegetable Garden displays new cultivars, including All-America Selections.

The 7½-acre Japanese Garden, designed by a Japanese architect and completed in 1967, contains a teahouse which was originally built for the New York World's Fair in 1965 as a gift of the Japanese Government.

The conservatory, and greenhouses covering 22,000 sq. ft., is one of the largest such installations in the southeast. Camellias, desert plants, a wide variety of bromeliads, orchids and ferns are featured inside.

Jasmine Hill Gardens

P.O. Box 6001 **(205) 263-1440**
Montgomery, AL 36106 **567-6362**

Hours: Tues.–Sun. 9–5.
Admission: fee charged.
Directions: U.S. 231 north of Montgomery to Jasmine Hill Rd. to Gardens.

Jasmine Hill Gardens, "Alabama's little corner of Greece," features a collection of Greek statuary in a 17-acre garden setting. Started privately in the 1920s, today the site is a public attraction and center for the performing arts.

Fountains, pools, stairways and hedges are accented with nearly 40 pieces of statuary, both original and copies, including a reproducton of the Temple of Hera, one of the oldest of Greek temples.

Bellingrath Gardens and Home

Route 1, Box 60 **(205) 973-2217**
Theodore, AL 36582

Hours: every day 7–dusk; house tours start at 8 a.m.

Oriental-American Garden at Bellingrath Gardens and Home, Theodore, Alabama

Admission: fee charged; additional fee for tour of the Home.
Directions: 20 mi. south of Mobile, exit I-10 or U.S. 90 at Theodore; take Bellingrath Hwy. to Gardens.

Bellingrath Gardens and Home, located on 65 acres overlooking the Isle-aux-Oies River, was built in the 1920s as the private estate of Walter and Bessie Bellingrath. Today, the display gardens contain 500 different kinds of plants, and the 15-room house is furnished with antiques and art objects. Just inside the entrance to the grounds, visitors come upon the Rose Garden, with over 20 beds. The central path through the Rose Garden leads to the Exotica Conservatory (1,500 sq. ft.).

Another section of the Garden centers around Mirror Lake. A terrace, summer house, rockery with bubbling pool, rustic bridge and masses of flowers surround the lake. The Oriental-American Garden features pools of water dotted with bridges and other garden structures. Opposite this is the Trial Garden.

Featured plants include live oaks, hundreds of camellias and more than 250,000 azaleas. Some 125,000 tulips and other bulbs fill the flower beds in spring. All-America Selections annuals follow and in the fall; over 60,000 chrysanthemums dominate.

The estate was opened to the public in 1932. In 1950 the Bellingrath-Morse Foundation, a not-for-profit organization, was formed to perpetuate the gardens.

Arizona

The Arboretum at Flagstaff

P.O. Box 670 **(602) 774-1441**
Flagstaff, AZ 86002

Hours: Mon.–Fri. 10–3.
Admission: no fee.
Directions: On Woody Mountain Rd. (U.S. Forest Service Rd. 230) 4 mi. south of junction of Old U.S. 66.

The 200-acre Arboretum is the only facility of its type in the Rocky Mountain West to be located above 6,000 feet elevation. It is devoted primarily to native plant propagation. Established in 1981, the Arboretum aims to serve as a resource for southwestern municipalities, developers and gardeners. The facilities include a passive solar greenhouse, research areas and offices. The first plantings were installed in 1983.

Desert Botanical Garden

1201 North Galvin Parkway **(602) 941-1225**
Phoenix, AZ 85008

Hours: every day 9–sunset; 7–sunset during July and Aug.
Admission: fee charged.
Directions: located in Papago Park on Galvin Pkwy. between Van Buren St. and McDowell Rd.
Public Transportation: accessible by City Bus 3E (marked "Zoo").

The Desert Botanical Garden is dedicated to the study of desert and arid-land plants. Since its founding by the Arizona Cactus and Native Flora Society in 1939, the Garden's purpose has been to study and conserve plants of these categories. Twenty of the site's 140 acres are open to the public, and display 1,800 species, including more than 1,000 kinds of cacti. Plants native to Arizona, Australia, Baja California, plus kinds mentioned in the Bible, are featured. Of particular concern to the Garden is the study of agaves.

Outdoor Cactus Garden, Boyce Thompson Southwestern Arboretum, Superior, Arizona

Boyce Thompson Southwestern Arboretum

Box AB **(602) 689-2811**
Superior, AZ 85273

Hours: every day 8–5:30, except Dec. 25.
Admission: fee charged.
Directions: located 3 mi. west of Superior on U.S. Hwy. 60.

The Boyce Thompson Southwestern Arboretum, cooperatively managed by the Arizona State Park Board, the University of Arizona and the Arboretum Board, is a living museum of desert plants. The Arboretum encompasses 300 acres, 30 of which are open to the public.

An outstanding collection of cacti and other succulents, a notable collection of eucalyptus and other mature arid-land specimens, such as Boojum Trees *(Idria columnaris),* form a portion of the 1,440 taxa grown. A network of trails leads visitors through the Australian area (Native Trees and Shrubs, Eucalyptus Grove, Palm Grove) Olives, Pines, Cactus Garden (Yucca and Agave, Natural Desert and Natural Riparian areas). The High Trail up the Queen Creek Canyon provides views of the gardens below.

The Arboretum was the dream of Colonel William Boyce Thompson, a successful businessman in the copper mining industry. He lived at the foot of Picket Post Mountain for nearly a decade, building his winter home and developing the Arboretum. The site was chartered in 1927 and formally dedicated in 1929.

Los Angeles State and County Arboretum

301 N. Baldwin Avenue **(213) 446-8251**
Arcadia, CA 91006

Hours: every day 9–5, except Dec. 25.
Admission: fee charged, except on the third Tues. of every month.
Directions: 210 Frwy. to Baldwin Ave.; south off-ramp to the Arboretum.
Public Transportation: accessible by bus.

The Los Angeles State and County Arboretum (LASCA) contains a collection of over 5,000 kinds of plants, both old favorites and new introductions, a historic preservation and a bird sanctuary. The 127-acre garden, like Sun Coast Botanic Garden and Descanso Gardens, is affiliated with the Los Angeles County Department of Arboreta and Botanic Gardens. It was founded in 1948 by the County and the California Arboretum Foundation.

Plants are grouped according to their geographic origins. Sections include South American, Mediterranean, South African, Australian and Asiatic-North American. Other displays of interest are the Aquatic Garden, Meadowbrook, Demonstration Home Gardens, Garden for All Seasons, Prehistoric and Jungle Garden, Native Oaks, Herb Garden and Palm and Bamboo collection.

In the historic area the ornate 1885 Queen Anne cottage, coach barn, restored adobe ranch house, Santa Anita Depot and Indian Wickiups are surrounded by the old-fashioned Rose Garden, Citrus Orchard and Historical Orchard. Another major attraction is the greenhouse complex (2,550 sq. ft.) where begonias, orchids and tropical plants are featured year-round.

Regional Parks Botanic Garden

Tilden Regional Park **(415) 841-8732**
Berkeley, CA 94708

Hours: every day 10–5, except Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: no fee.
Directions: from Berkeley take Spruce St. off University Ave. to Wildcat Canyon Rd; east of Berkeley.

Nestled in Wildcat Canyon in the center of Tilden Regional Park is this 9-acre botanic garden, devoted to the collection, display and preservation of native California plants. Gathered here are over 2,000 different plant taxa, representing all of the various habitats of California.

The Garden is divided into 10 sections, each corresponding to areas of the state, including Southern California, Valley, Santa Lucia, Channel Island, Franciscan, Pacific Rain Forest, Sierra, Redwood, Sea Bluff and Shasta. Noteworthy plant collections include conifers, oaks, manzanitas *(Arctostaphylos)*, ceanothus, bunchgrasses, aquatics, endangered plants of California (over 200 species) and more generally, mature woody plants. The Botanic Garden was opened to the public in 1940.

University of California Botanical Garden

Centennial Drive **(415) 642-3343**
Berkeley, CA 94720

Hours: every day 9–4:45, except Dec. 25.
Admission: no fee.
Directions: on Centennial Dr. in Strawberry Canyon, directly behind the main campus of the University of California, Berkeley.
Public Transportation: accessible by free shuttle bus from Berkeley.

This 30-acre university garden was founded in 1890 by the Botany Department. Today the department still administers the Garden and its displays of 9,000 plant taxa.

Outstanding collections include cacti and succulents, orchids, rhododendrons, California natives and South African plants. But plants from most of the major temperate regions of the world are represented in geographically arranged collections: Mediterranean and European, South American, Pacific Islands, New Zealand, Asian, Himalayan, Australian, Eastern North American, African Hill, New World

Desert, Mexican and Californian. Additional enjoyable sections include the Palm Garden, Japanese Pool, Herb Garden, Plants for Mankind, Orchard and Mather Redwood Grove. Three greenhouses (5,000 sq. ft.) are filled with ferns, orchids, cacti and tropical plants.

Virginia Robinson Gardens

1008 Elden Way **(213) 276-5367**
Beverly Hills, CA 90210

Hours: Tues.–Fri. by reservation only.
Admission: fee charged.
Directions: in Beverly Hills, just north of Los Angeles; see address.

Rancho Santa Ana Botanic Garden

1500 North College Avenue **(714) 625-8767**
Claremont, CA 91711

Honrs: every day 8–5, except Jan. 1, July 4, Thanksgiving Day and Dec. 25.
Admission: no fee; donations encouraged.
Directions: Along Frwy. 10 take the Indian Hill exit and go about 2 mi. north to Foothill Blvd., then 3 blocks east to College Ave.; by way of Frwy. 210, travel 4.5 mi. east from the frwy.'s end along Foothill Blvd. to College Ave.

The Rancho Santa Ana Botanic Garden, a private research and educational institution founded in 1927, is devoted to the field of California flora. In 1951 the garden moved to its current 85-acre site, and presently is the largest botanic garden in the U.S. to focus on plants native to California. The collection consists of about 1,500 species and cultivars. On the Indian Hill Mesa portion of the grounds, plants are displayed to emphasize their ornamental value, while remaining collections consist of plants collected from the wild, documented and grouped according to 19 botanical categories. The Garden is one of 16 designed as centers for study relating to threatened and endangered plants.

Highlights include the desert garden containing cactus species: the coastal garden featuring plants from the state's shoreline; Woodland and Riparian Trails through a cool oak forest and along streams and ponds; the manzanita display area and the conifer and ceanothus collections. A spectacular display of California wildflowers carpets the mesa from mid-March through May.

Sherman Library and Gardens

2647 E. Coast Highway **(714) 673-2261**
Corona Del Mar, CA 92625

Hours: Gardens, every day 10:30–4; Library, Mon.–Fri. 9–5; Garden Shop, every day 10:30–3:30; closed Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: fee charged every day but Mon.
Directions: located 40 mi. south of Los Angeles; take frwy. to Irvine; exit at MacArthur Blvd.; follow MacArthur south to Coast Hwy.; turn left, go one block.
Public Transportation: accessible by Rapid Transit Bus.

University of California Arboretum—Davis

Department of Botany **(916) 752-2498**
University of California
Davis, CA 95616

Hours: grounds, year-round, all hours; Arboretum office, Mon.–Fri. 8–5, except holidays.
Admission: no fee.
Directions: just north of I–80, on the University of California campus at Davis; Arboretum office on La Rue Rd., across from campus parking lot #46.

The University of California Arboretum is a 110-acre, 2-mile strip of land flanking both banks of the Putah Creek. Affiliated with the University's Department of Botany, the

arboretum contains about 1,500 kinds of plants.

The Acacia Section contains 80 different acacia species; the Shields Grove area is devoted to oaks (75 species); the Exotic Conifer Section to cone-bearing trees from foreign countries; the Native Plant Section to plants from the Sierra Nevada and Coast Ranges; the Desert Section to plants from the southwest; the Exotic Section to woody plants from Australia, South Africa and the Mediterranean region (eucalyptus trees are prominent). Also featured is a redwood grove planted in 1941.

The Arboretum was started in 1936 by staff and students of the University. Numerous California species were planted in 1940–41, and in 1968–69 an extensive development project was carried out.

Quail Botanical Gardens

230 Quail Gardens Drive (714) 753-4432
Encinitas, CA 92024 436-3036

Hours: in winter, every day 8–5; in summer, 8–6.
Admission: no fee; parking fee charged.
Directions: 27 mi. north of San Diego off I–5; take Encinitas Blvd. ¼ mi. east of Quail Gardens Dr.

About half of the Quail Botanical Gardens' 30 acres is a display garden, while the other half is a wildlife sanctuary. Nearly 3,000 kinds of tropical, subtropical, and California native plants can be found here. The installation was originally the private estate of Ruth Baird Larabee, until 1957 when she donated her house and 27 acres to the County of San Diego. The Quail Botanical Gardens Foundation was established in 1961.

Plant groups emphasized include fuchsias, hibiscus, bamboos (Quail Botanical Gardens is an official test facility for these plants), proteas, cacti and succulents, and other drought-tolerant plants such as Australian shrubs. Herbs, water plants, wildflowers, South American and Australian perennials, brugmansias, cork oaks and palms are also featured. The Mildred MacPherson Waterfall is one of the most popular spots in the garden, and buildings dating from 1850 to 1920 add a historic atmosphere. These include Encinitas's first meeting hall, first schoolhouse and the Larabee residence.

Ficus *trees at South Coast Botanic Garden, Palo Verdes, California (photo: William Aplin)*

Mendocino Coast Botanical Gardens

18220 N. Highway 1 **(707) 964-4352**
Fort Bragg, CA 95437

Hours: in winter, every day 8:30–5; in summer, 8:30–6; closed holidays.
Admission: fee charged.
Directions: 1 mi. south of Ft. Bragg, 6 mi. north of Mendocino on Hwy. 1.

Fullerton Arboretum

California State University, Fullerton **(714) 773-3579**
800 N. State College Boulevard
Fullerton, CA 92634

Hours: every day 8–4:45, except Dec. 25 through Jan. 1 and other major holidays; Heritage House is open for guided tours Sun. 2–4; closed August.
Admission: no fee for grounds; fee charged for Heritage House.
Directions: located at the northeast corner of California State University, Fullerton; adjacent to Frwy. 57 at Yorba Linda Blvd; entrance from Associated Rd.
Public Transportation: accessible by bus.

Fullerton Arboretum has three stated purposes: to create a quiet retreat in a rapidly growing urban area; to provide California State University and the local community with a resource for environmental and historical education, and to conserve natural resources. The 26-acre site was opened to the public in 1979 following 10 years of development.

Plants are arranged according to their habitat requirements. A stream and ponds provide moisture for evergreen conifers, deciduous trees, tropicals and bog plants. Arid environments include oak woodlands, chaparral, deserts and thorn scrub. Other points of interest are the Palm Grove, Rare Fruit Grove, rose gardens and community gardens.

The Heritage House area is the focal point of the Arboretum. The House, built in 1894, has been carefully restored and is surrounded by structures and gardens typical of the 1890's.

East Garden, the J. Paul Getty Museum, Malibu, California (photo: Julius Shulman)

Blake Garden

Location address:	Mailing address:
70 Ricon Road	2 Norwood Place
Kensington, CA 94707	Kensington, CA 94707
	(415) 524-2449

Hours: weekdays 9–4:30; closed weekends and holidays.
Admission: no fee.
Directions: in Kensington, which is north of Berkeley, across the bay from San Francisco.
Public Transportation: accessible by bus.

Descanso Gardens

1418 Descanso Drive (213) 790-5571
La Canada, CA 91011

Hours: every day 9–5, except Dec. 25.
Admission: fee charged except on the third Tues. of every month.
Directions: located in La Canada-Flintridge, near the junction of Frwy. 210 and Rt. 2
Public Transportation: accessible by bus.

Descanso Gardens, built on 160 acres of native chaparral-covered slopes (80 acres are open as a display garden), is operated by the Los Angeles County Department of Arboreta and Botanic Gardens.

Descanso has "the largest plantings of camellias in the world," with thousands of specimens, representing over 600 varieties. A forest of California live oaks forms a canopy over the plantings of camellias and azaleas. Roses fill a 5-acre section. Other areas include the Cymbidium Orchid Dell, Fern Dell, California Native Plants and plantings of daylilies. Near the entrance of the grounds is the Oriental Tea House, surrounded by a garden donated by the Japanese-American community. Hospitality House, with adjoining Meditation Garden, is a 1939 mansion, the original residence of the Garden's builder.

In 1957 a group of citizens formed the Descanso Gardens Guild to protect and promote the gardens.

Mildred E. Mathias Botanical Garden

University of California (213) 825-2714
Los Angeles, CA 90045

Hours: weekdays 8–5; weekends 8–4; closed University holidays.
Admission: no fee.
Directions: from San Diego Frwy. (I–405) to Wilshire Blvd.; east on Wilshire to Westwood Blvd. and north. Upon entering the campus, Westwood becomes Westwood Plaza. At kiosk, obtain parking permit (fee charged). The Garden is at the southeast corner of the campus and is bordered by Hilgard and Le Conte Aves.
Public Transportation: accessible by bus.

The Mildred E. Mathias Botanical Garden, displaying 4,000 kinds of plants, is set in a natural canyon with a stream running through it. It features a wide variety of subtropical ornamental trees and shrubs and many unusual species not commonly seen in the California landscape. Australian, desert, and Acanthus-Family plants, palms, cycads and native plants are emphasized collections. The UC Biology Department started the Garden in 1929.

The J. Paul Getty Museum

17985 Pacific Coast Highway (213) 459-2306
Malibu, CA 90265 458-2003

Hours: Tues.–Sun. 10–5; closed Dec. 25, July 4, Jan. 1 and Thanksgiving Day.
Admission: no fee; make parking reservations at least one week in advance, at no charge; due to an agreement with local residents, pedestrians are not permitted into the museum. Bus passengers may obtain a museum pass from the driver.
Public Transportation: accessible by RTD bus line #434.

The J. Paul Getty Museum, housed in a re-creation of the Villa dei Papiri, is surrounded by five gardens based on excavations of the 1st-century A.D. villa. When Mr. Getty's art collection outgrew his Malibu mansion, he built the villa to house his Greek and Roman antiquities, Renaissance and Baroque paintings, and decorative arts. The building opened in 1974, two years before his death.

In the Main Peristyle Garden, a long reflecting pool and bronze statues, based on the originals excavated from the villa, are framed by clipped shrubbery and trees. Next door lies the Herb Garden. In the smaller East and West and Inner Peristyle Gardens, fountains and wall frescoes are featured with the plantings. The 1,000 trees, shrubs, flowers and herbs used in the design are kinds that might have been growing in the original villa.

The Living Desert

47-900 Portola Avenue **(619) 346-5694**
P.O. Box 1775
Palm Desert, CA 92261

Hours: every day 9–5, except June–August.
Admission: fee charged.
Directions: from Los Angeles (150 mi.) east on I–10 to Bob Hope Dr. exit; south on Bob Hope Dr. to Hwy. 111 to Portola Ave. (in Palm Desert); south 1½ mi.
Public Transportation: accessible by bus.

The Living Desert, an ecological preserve and interpretive center, offers live animal exhibits, botanical gardens and nature trails. Nine hundred acres of the 1,300-acre reserve are open to the public; 500 kinds of desert plants are displayed on 25 acres devoted to gardens. A variety of North American desert-type plants is represented in the Agave Garden, Mojave Garden, Lower Colorado Sand Dune, Upper Colorado Garden, Opuntia Garden, Baja Garden and Indian Garden. In the Indian Garden visitors learn how desert plants were used by local native Americans.

Visitors may explore the natural areas, spread over six miles of trails up Eisenhower Mountain and into a canyon. Wildflowers bloom from January to May. The preserve was established in 1952 by Philip Boyd.

South Coast Botanic Garden

26300 Crenshaw Blvd. **(213) 772-5813**
Palo Verdes Peninsula,
CA 90274

Hours: every day 9–5, except Dec. 25.
Admission: fee charged, except on the third Tues. of every month.
Directions: from Los Angeles take Harbor Frwy. to Pacific Coast Hwy. (101) west to Crenshaw Blvd.; south on Crenshaw about 1 mi.

South Coast Botanic Garden sits on 3½ million tons of refuse covered with topsoil. It is one of the first botanic gardens to be developed over a sanitary landfill. The 87-acre site, first planted in 1961, contains more than 2,000 species. The Garden is administered by the Los Angeles County Department of Arboreta and Botanic Gardens.

A one-mile road circles the site, while numerous paths and walkways allow visitors to explore the inner regions. Features include the Fruiting Orchard, Shade Garden, Vegetable Display Garden and herbaceous ground covers. The Garden is particularly rich in plants from Australia, the Mediterranean and South Africa.

Filoli Center, Woodside, California (photo: Carol Ivie)

Institute of Forest Genetics
(The Eddy Arboretum)

Pacific Southwest Forest and Range Experiment Station
Forest Service,
U.S. Department of Agriculture
2840 Carson Road
Placerville, CA 95667
(916) 622-1225

Hours: Mon.–Fri. 8–4:30; closed weekends and holidays.
Admission: no fee.
Directions: 3 mi. east of Placerville on Carson Rd.

The Institute of Forest Genetics, operated by the Forest Service of the U.S. Department of Agriculture, is known internationally for pioneering research in the hybridization of pines. Fifteen acres of the 160-acre experiment station offer visitors a display of conifers; pines of the world (about 70 species) grow along the Eddy Arboretum Trail. The arboretum was donated to the people of the United States by James G. Eddy in 1925.

University of California
Botanic Gardens-Riverside

Department of Botany and Plant Science
Riverside, CA 92521
(718) 787-4650

Hours: every day 8–5, except Jan. 1, July 4, Thanksgiving Day and Dec. 25.
Admission: no fee.
Directions: exit frwy. in Riverside at University Ave.; Gardens on the east side of campus, off East Campus Drive, through Parking Lot 13.

The 39-acre Botanic Gardens of the University of California at Riverside display 3,000 kinds of plants for teaching, research and public enjoyment. Featured areas include the Cactus and Succulent Garden, Rose Garden, Iris Garden, Herb Garden and Daylily Garden. Southwest-Desert and Australian shrubs and trees, plus *Ficus* species, are emphasized in the woody plantings. In the greenhouse (3,000 sq. ft.; open upon request), cycads are prominent. The Gardens were established in 1963.

San Diego Zoo

P.O. Box 551
San Diego, CA 92112
(714) 231-1515
234-3153

Hours: July to Labor Days everyday 9–5; otherwise 9–4
Admission: fee charged (group rates available); free on Founder's Day in Oct.
Directions: in Balboa Park, just east of Rt. 163; Wild Animal Park* is about 30 mi. north of downtown San Diego via I–15 (Hwy. 163); exit via Rancho Pkwy. to San Pasqual Rd.; follow signs.
Public Transportation: accessible by bus.

The San Diego Zoo's 3,200 animals (800 species) are displayed in a 100-acre tropical-garden setting; most are contained in moated enclosures that approximate the animals' native habitats. Major plant collections are tropical, subtropical and warm tropical, including cycads, aloes, figs, palms, bamboo, ferns, orchids, bromeliads, euphorbias, erythrinas, eucalyptus, South African bulbs, bananas and tropical conifers. The Zoo also serves as an official test garden for local landscape introductions. In the Zoo and surrounding Balboa Park, over 5,000 plant species are grown.

*The Zoo also maintains Wild Animal Park, a 1,800-acre sanctuary. Conservation is the primary goal here and animals roam freely in natural settings. Visitors may observe them from a monorail train or from a hiking trail. Hours: June 21 to Labor Day, Mon.–Thurs. 9–6; Fri.–Sun. 9–8; Labor Day to June 20, 9–4. Call (619) 234-6541, 480-0100 or 747-8702 for further information.

Sea World of California

1720 S. Shores Road (619) 226-3901
San Diego, CA 92109

Hours: every day 9–dusk; June to Labor Day 9–11.
Admission: fee charged.
Directions: take Sea World Drive exit off I–5 or take E. Mission Bay Drive exit off I–8 to Sea World Drive.
Public Transportation: accessible by San Diego Transit; call (619) 233-3004 for routes and schedules.

Sea World is a marine zoological park presenting six shows and thirty educational exhibits. It also features over 4,000 species of plants on its 135-acre landscaped site. Horticultural highlights include planted water areas (where one of the largest water-fowl collections in the U.S. can be seen), the Japanese Garden (with a reproduction of Kyoto's Golden Pavilion), the Trough Garden (containing many alpine plants) and the Rock Garden (small plants, ground covers, dwarf conifers, palms, cycads, bamboos and ferns). Annuals and perennials flower throughout the year.

Most of the plants in the park were selected for their ability to withstand a salt-laden, seaside environment. Sea World opened to the public in 1964.

Japanese Teahouse, Descanso Gardens, La Canada, California (photo: Bobby Vargas)

Conservatory of Flowers—Golden Gate Park

Location:	Mailing Address:
J.F. Kennedy Dr.	McLaren Lodge
San Francisco, CA	Fell and Stanyan Streets
(415) 558-3973	San Francisco, CA 94117

Hours: Apr.–Oct. every day 9–6; other times 9–5.
Admission: fee charged, except on the first Wed. of each month, major holidays and from 9–9:30.
Directions: Conservatory is in Golden Gate Park, ½ mi. west of Stanyan St. at the beginning of the Park. Take Fell St. exit from U.S. 101; 2 mi. south of Bay Bridge.
Public Transportation: accessible by #5 Fulton bus.

Within the 1,000-acre Golden Gate Park is the Conservatory of Flowers, a Victorian structure erected in 1879. In the historic structure's 11,000 sq. ft. under glass, about 4,500 kinds of plants are grown. Restoration of the Conservatory's decorative details was undertaken in 1983.

Tropical plant collections include begonias, gesneriads, bromeliads, orchids, aroids, carnivors, palms, cycads and ferns. In addition to the permanent installations, seasonal floral displays are featured year-round.

Strybing Arboretum and Botanical Gardens

Ninth Avenue at Lincoln Way **(415) 558-3622**
San Francisco, CA 94122

Hours: weekdays 8–4:30; weekends and holidays 10–5.
Admission: no fee.
Directions: Hwy. 1 north; turn right at Lincoln Way.
Public Transportation: MUNI Metro north to Ninth Avenue.

Strybing Arboretum and Botanical Gardens, located in San Francisco's Golden Gate Park, benefits from the Mediterranean climate of coastal California. Featured plants include

Hearst Castle, San Simeon, California

those from areas of similar climate, namely Australia, New Zealand, South Africa, central Chile and the Asiatic cloud forest. Rare rhododendrons and magnolias are featured among the 5,000 species grown. Individual gardens include the Garden of Fragrance, Succulent Garden, Conifer Garden, Biblical Garden and demonstration gardens for the homeowner. Construction of the Arboretum began in 1937.

Hungtington Botanical Gardens

1151 Oxford Road **(818) 405-2100**
San Marino, CA 91108

Hours: Tues.–Sun. 1–4:30 (Sun. by advance-ticket reservation only; write or call ahead of time); closed Mon. and major holidays; Art Gallery and Library open the same hours.
Admission: no fee; suggested contribution.
Directions: 1½ mi. south on Allen Ave. from Foothill Frwy. (210) in Pasadena. Exit Allen Ave. (if coming from the east); exit Hill Ave. (if from the west) and take access road to Allen Ave.; 12 mi. northeast of downtown Los Angeles.

Public Transportation: accessible by bus; stop within 3–4 blocks.

The one-time private estate of the Henry E. Huntingtons is today a place of learning and beauty. The library houses 600,000 books of American and English history and literature, while the Art Gallery contains the most comprehensive collection of 18th- and 19th-century British art outside London. A dozen display gardens contain over 15,000 different kinds of plants. About 130 of the 207 acres are open to the public.

The North Vista, directly north of the Art Gallery, is an expanse of lawn lined with azaleas, camellias, palms and 17th-century Italian statuary. The Shakespeare Garden contains an acre of plants that were cultivated in English gardens during Shakespeare's time. The Rose Garden has more than 1,000 varieties arranged historically. The five-acre Japanese Garden features the 19th-century Japanese house, temple bell and pavilion, moon bridge, and bonsai court. The Zen Garden, of sand, was added in the 1960s. The 12-acre Desert Garden, with 5,000 species, is the "largest outdoor collection of desert plants in the world." Another expansive collection is devoted to camellias (1,500 varieties). In the Palm Garden about 200 mature specimens can be seen, and in the Australian Garden over 100 varieties of eucalyptus are grown, along with acacias and bottlebrushes.

In 1903 Henry E. Huntington bought working ranchland sparsely covered with native vegetation. During the next 24 years he turned it into lush gardens and a haven for scholars.

Hearst Castle
(Hearst San Simeon State Historical Monument)

P.O. Box 8 **(805) 927-4622**
San Simeon, CA 93452

Hours: every day 8:30–3, except Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: fee charged; reservations recommended.
Directions: located just off California Scenic Hwy. 1, east of San Simeon; from San Francisco take Hwy. 101, exit 46 west, 2 mi. after Paso Robles; north on Hwy. 1 for 45 mi.

William Randolph Hearst (1863-1951) created La Cuesta Encantada (The Enchanted Hill) with acres of gardens, terraces, pools, palatial guest houses and the 137-foot tall, 100-room Hispano-Mooresque mansion, Casa Grande. He started construction in 1919 on the then-240,000-acre family ranch. Today, the estate is owned and operated by the State of California, Department of Parks and Recreation. The property contains one of the nation's outstanding collections of art objects and five acres of gardens.

Prominent plants in the landscape include Italian cypress, palms and California native live oaks. Oleanders, citrus, pomegranates, persimmons, quince, roses, camellias, rhododendrons, perennials and annuals are also found in the formal and informal gardens surrounding the buildings.

Santa Barbara Botanic Garden

1212 Mission Canyon Road **(805) 682-4726**
Santa Barbara, CA 93105

Hours: every day 8–sunset.
Admission: no fee.
Directions: 3 mi. north of Santa Barbara; Rt. 101 to Los Olivos St., turn right on Mission Canyon Rd. behind the Old Mission and follow the signs.

Santa Barbara Botanic Garden is a picturesque 65-acre display garden devoted to California native flora. Plants from the deserts, grasslands and offshore islands are arranged in naturalistic settings. Five miles of trails lace the area. Special attractions include the Ceanothus Section, the Meadow Section with massive live oaks and a water garden, the Desert Section (colorful in early summer) and a Redwood Grove bordering the creek. Plants from offshore islands are offered in the Island Section in the lower canyon. The installation dates from 1926 when Anna Bliss founded it as a public display garden.

UCSC Arboretum

University of California
Santa Cruz, CA 95064

Hours: Wed. and weekends 2–4.
Admission: no fee.
Directions: located on campus; entrance on Empire Grade ¼ mi. northwest of the Empire Grade and Western Dr. intersection.
Public Transportation: accessible by metropolitan bus.

The UCSC Arboretum specializes in woody plants of unusual scientific interest and ornamental shrubs from regions with mild climates. Half of the 80 acres open to the public display about 4,000 different types of plants.

At the Elevenia J. Slosson Research Gardens, also on campus, is an excellent selection of Australian ornamentals. The Gardens are the result of an extensive program of importing material, and they change continually as new introductions are added. They now contain over 1,000 cultivars.

Three greenhouses (1,500 sq. ft.), primarily used for propagation, are also open to the public.

Gazebo and Water Lily Pool, Denver Botanic Gardens, Denver, Colorado

Hakone Japanese Garden

21000 Big Basin Way **(408) 867-3438**
Saratoga, CA 95070

Hours: Mon.–Fri. 10–5; Sat.–Sun. 11–5; closed legal holidays.
Admission: no fee; donation requested.
Directions: Hwy. 280 to Saratoga Ave. off ramp; south on Saratoga Ave. about 5 mi. (pass through downtown area of Saratoga); Garden is on the left just outside town (Saratoga Ave. changes to Big Basin Way).

Filoli Center

Canada Road **(415) 364-2880**
Woodside, CA 94062

Hours: mid–Feb. to mid–Nov. Tues.–Sat.
Admission: fee charged; advance reservations required; visitors must be 12 yrs. of age or older.
Directions: located 25 mi. south of San Francisco, just off Hwy. 280. Take Edgewood exit west, turn north on Canada Rd.; 1.3 mi. to the gate.

Filoli, a property of the National Trust for Historic Preservation, is a reflection of the opulent manner of living of wealthy San Franciscans Mr. and Mrs. William B. Bourn II during the early 20th century. The mansion, built between 1916 and 1919, is a definitive example of country-home architecture. It is surrounded by 16 acres of gardens originally designed by Bruce Porter and Isabella Worn. The mature plantings, buffered by more than 600 acres of wilderness, combine formal design with natural surroundings. The Walled Garden contains fountains, clipped hedges, columnar evergreens, graceful flowering trees and an Italian-Renaissance teahouse. The interior of the teahouse emphasizes container plantings. The rose garden, formal parterres, perennial and annual borders (All-America Selections), plantings of azaleas, rhododendrons, camellias and magnolias, lawns and

reflecting pools form other sections of the formal garden.

To administer the property, a not-for-profit corporation, Filoli Center, was established in 1976.

Colorado

Denver Botanic Gardens

909 York Street **(303) 575-2547**
Denver, CO 80206

Hours: every day, except Dec. 25, Jan. 1 and the Thurs. before Mother's Day.
Admission: fee charged, except during Plant and Christmas Sales.
Directions: 2½ mi. north on University (York) St. from I–25; 3½ mi. south on York from I–70.

On 22 intensively landscaped acres, Denver Botanic Gardens display 10,000 kinds of plants. The Gardens are an agency of the City and County of Denver, Department of Parks and Recreation.

The Conservatory and Orchid/Bromeliad Pavilion display over 800 tropical and subtropical plants — more than 1,000 species of orchids and 1,200 species of bromeliads. Over 13,000 sq. ft. under glass are open to the public. The one-acre rock garden is filled with alpine plants, while seasonal displays of tundra plants are found in the Alpine House. Shofu-en, a Japanese Garden with a naturalistic lake, features handcrafted bridges, gates and a teahouse. In the Herb Garden fragrant and ancient herbs are arranged in traditional bowknot pattern.

Other specialized areas include: a simulated Rocky Mountain landscape; Landscape Demonstration Garden (illustrating low-maintenance and intensive-gardening styles); Scripture Garden; Dahlia, Iris and Daylily, Peony, Lilac, and Plains Gardens; All-America Rose Selection Test Plots; demonstration area for annuals, turf and vegetables; Juniper Mound, and a pergola dressed with vines. The various areas of the Gardens are connected by a system of waterfalls, fountains and pools.

The Gardens were founded in 1951 by a group of interested citizens. Construction began in 1959 and the plantings have been expanding ever since.

The Denver Botanic Gardens facility also oversees three additional sites: The Chatfield Arboretum, a 700-acre tract (under construction) in the foothills near Chatfield Dam and Reservoir southwest of Denver; the Walter S. Reed Botanical Garden, a 20-acre preserve located west of Denver near Evergreen in the montane zone, and Mount Goliath Alpine Unit, a 160-acre area 50 miles west of Denver with a two-mile nature trail that winds through alpine and subalpine zones. The first two are open to the public only at selected times and may be seen by contacting the main office at 909 York Street. The Alpine Unit is open during the summer months.

Connecticut

New Canaan Nature Center

144 Oenoke Ridge **(203) 966-9577**
New Canaan, CT 06840

Hours: Tues.–Sat. 9:30–4:30; Sun. 12:30–4:30; closed Mon. and major holidays.
Admission: no fee.
Directions: ½ mi. north of New Canaan on Rt. 124.

Donated to the community, the New Canaan Nature Center was established in 1959 on the former estate of Susan Dwight Bliss. The Horticultural Education Building, a solar-heated complex with greenhouse space (3,000 sq. ft.) was added in 1983. Landscaped areas on the 40-acre property include a wildflower garden, herb garden and large perennial border.

Connecticut Arboretum

Connecticut College **(203) 447-1911**
Williams Street **ext. 7700**
New London, CT 06320

Hours: every day sunrise–sunset.
Admission: no fee; information and bulletins in Botany Office, 209 New London Hall.
Directions: main entrance to Connecticut College is on the west side of Rt. 32, about 1 mi. north of I–95 in New London; cross the campus to the William St. main gate to the Arboretum.
Public Transportation: accessible by bus from downtown New London.

Along the periphery of Connecticut College's campus are several tracts of land (a total of over 400 acres) that comprise the Connecticut Arboretum. The diversity of sites has served the college as an outdoor laboratory, and the community and visitors as a park, nature study area and wildlife refuge since 1931. The Arboretum is administered by the Botany Department.

From the main entrance to the Arboretum, Laurel Walk leads visitors amid mountain laurel, down to the Arboretum Pond. Surrounding the pond is a collection of over 200 kinds of native trees and shrubs. Plantings include pines, viburnums, azaleas, hawthorns, birches, hollies, oaks and conifers. Next to the pond is the Outdoor Theater, screened with hemlock. Other points of interest include Buck Lodge (a rustic stone building used for meetings), the Edgerton Wildflower Area and the naturalistic Landscape Demonstration Area.

The Arboretum also maintains, across campus, the Caroline Black Botanic Garden. This four-acre landscaped area contains a collection of ornamental trees, shrubs and dwarf plants. Several other sites, along public roads, demonstrate vegetation management through the selective use of herbicides.

Bartlett Arboretum

The University of Connecticut **(203) 322-6971**
151 Brookdale Road
Stamford, CT 06903

Hours: Arboretum, every day 8:30–sunset; library, weekdays 8:30–4.
Admission: no fee.
Directions: 7 mi. north of Stamford on High Ridge Rd. (Rt. 137); left onto Brookdale Rd.
Public Transportation: Conrail; bus from train station; ¼ mi. from the bus stop.

Hagley Museum and Library, Wilmington, Delaware

Bartlett Arboretum, a part of the Department of Plant Science of The University of Connecticut, functions primarily as a teaching facility for public education. The 63-acre Arboretum features the Dwarf Conifer Garden, Ericaceous Collection and small flowering trees. The facility was established in 1965 with funds from a private estate.

Harkness Memorial State Park

275 Great Neck Road **(203) 443-5725**
Waterford, CT 06385

Hours: grounds, every day 8–sunset; buildings, every day, Memorial Day to Labor Day, 10–5.
Admission: fee charged.
Directions: I–95, exit 74; south on Rt. 161 to Niantic; east on Rt. 156 to Rt. 213.

Formerly the estate of Edward S. Harkness, this 125-acre site on Long Island Sound was left to the State of Connecticut in 1950. Surrounding the 42-room mansion (built in 1902) are the Italian Garden (with a water-lily pool), Oriental Garden, Cutting Garden and greenhouse complex.

Delaware

The Hagley Museum and Library

P.O. Box 3630 **(302) 658-2400**
Greenville,
Wilmington, DE 19807

Hours: every day 9:30–4:30, special winter hours Apr.–Dec.
Admission: fee charged.
Directions: from I–95, either Rt. 52 or Rt. 202 exits; located on Rt. 141 between Rts. 52 and 202; 1 hr. from Philadelphia.

Hagley Museum, situated along the scenic Brandywine River, offers a look at American industrial life in the 19th century. On the 230-acre site, a museum (formerly a textile mill) and original du Pont black-powder mills trace America's industrial development. Upstream lies Eleutherian Mills, the Georgian-style mansion built in the 1800s by E. I. du Pont. A garden at the front of the mansion has been restored to the period of its first cultivation by Mr. du Pont. About two acres were excavated to determine original locations of paths and garden structures, and household accounts and letters provided documentation for the 100 kinds of plants found in the garden today.

On the hillside below the mansion, the Renaissance-Revival garden created by Louise du Pont Crowninshield and her husband during the 1920's has also been stabilized. This romantic garden features terraces and statuary.

In preparing to celebrate the sesquicentennial of E. I. du Pont de Nemours and Company, family members and corporate personnel decided to preserve the historic Brandywine site. The Eleutherian Mills-Hagley Foundation was formed in 1954, and the museum opened to the public in 1957. By 1972 the plan for restoring the garden had been completed.

Nemours

Location: **(302) 651-6912**
Rockland Road **Mailing Address:**
Reservations Office
P.O. Box 109
Wilmington, DE 19899

Hours: May–Nov., Tues.–Sat.; tours at 9, 11, 1 and 3; Sun. tours at 11, 1 and 3; arrive 15 minutes before tour times.
Admission: fee charged; advance reservations highly recommended; must be at least 16 yrs. of age.
Directions: on Rockland Rd., between US Rt. 202 and St. Rt. 141.

Winterthur Museum and Gardens

Winterthur, DE 19735 **(302) 654-1548**

U.S. National Arboretum, Washington, D.C.

Hours: Tues–Sat. 10–4; Sun. and holiday Mon. 12–4; otherwise closed Mon., Jan. 1, July 4, Thanksgiving Day, Dec. 24–25.
Admission: fee charged; a variety of tours.
Directions: 6 mi. northwest of Wilmington on Rt. 52; exit 7 off I–95.
Public Transportation: limited bus service from Wilmington.

Winterthur, the former home of Henry Francis du Pont, is known for its extraordinary collection of American antiques. These are displayed throughout the 196 rooms of the sprawling mansion. The 200 acres of surrounding gardens, designed by du Pont, remain one of the finest examples in this country of landscaping in the English naturalistic style. Today, the gardens as a whole typify the large country estates developed during the first half of the 20th century.

Gentle winding paths allow visitors to wander through woods, garden areas and plantings and enjoy about 4,000 different kinds of plants. Under stands of mature hardwoods in the Azalea Woods, drifts of Kurume azaleas are combined with rhododendrons, dogwoods, viburnums, bulbs and wildflowers. At the woods' edge saucer magnolias accent the landscape. The nearby Witch Hazel Area provides one of the first big spring displays, while the March Bank, covered with bulbs peaks in the month of its name. The Pinetum contains unusual specimens of conifers (more than 50 species and varieties) planted in 1914. From Oak Hill, meadows, streams, ponds and woodlands can be surveyed throughout the year.

Closer to the mansion are the Reflecting Pool Area and the Peony Garden. An abandoned quarry, developed into a naturalist garden, features native and exotic bog plants, including sweeps of primulas.

H. F. du Pont inherited Winterthur in 1927 and until his death in 1969, he developed the grounds, mansion and collections. In 1930 he established a private foundation to care for the estate.

District of Columbia

Bishop's Garden of Washington Cathedral

Mt. St. Alban **(202) 537-6200**
Washington, D.C. 20016

Hours: grounds, every day sunrise–7.
Admission: no fee.
Directions: on Wisconsin Ave. NW, between Woodley Rd. and Massachusetts Ave. NW.
Public Transportation: accessible by Washington city buses.

Dumbarton Oaks

1703 32nd Street NW **(202) 338-8278**
Washington, D.C. 20007

Hours: grounds, every day 2–5, except holidays; Museum, Tues.–Sun. 2–5, except holidays.
Admission: fee charged, except Nov.–Mar.
Directions: located in the northwest section of the city, in Georgetown; garden entrance at 31st and R Sts.
Public Transportation: accessible by bus; stop one block away.

Dumbarton Oaks is referred to by some as the "last great American garden." The 16 acres surrounding a Georgian-style mansion represent the creative efforts of Mrs. Beatrix Farrand, the noted landscape architect, and Mrs. Robert Woods Bliss.

From 1922 the two worked together for 25 years on the estate, perfecting the garden with the best ornamental plant materials available.

The garden comprises a series of terraces built on a hill behind the house, with the remaining areas laid out in informal plantings. Courtyard-terrace areas include the Star Garden, Green Garden, Swimming Pool, Beech Terrace, Urn Terace, formal Rose Garden, Arbor Terrace, Fountain Terrace, Lovers' Lane Pool and the Pebble Terrace. This last features a pebble mosaic of a wheat sheath glimmering under a thin layer of water. The Camellia Circle, Prunus Walk, Cherry Hill, Crabapple Hill, Forsythia Hill and Fairview Hill radiate from the Ellipse, a circular fountain ringed by walks and clipped trees.

Mr. and Mrs. Bliss acquired Dumbarton Oaks in 1920 when they began adding to the 1801 mansion and developing the grounds. In 1940 the Blisses gave Dumbarton Oaks to Harvard University as a means of preserving the estate and collections. The gardens opened to the public soon after.

Oak Hill Cemetery

3001 R Street NW **(202) 337-2835**
Washington, D.C. 20007

Hours: every day 9–5, except Sat., Sun. and national legal holidays.
Admission: no fee.
Directions: in Georgetown on R St. NW, 3 blocks east of Wisconsin Ave.; at the north end of 30th St.; a neighbor of Dumbarton Oaks.
Public Transportation: accessible by Washington Metropolitan Transit System.

The 25 acres of Oak Hill Cemetery form a naturalistic, picturesque landscape dating from the first half of the 19th century. Established by W. W. Corcoran in 1849, the garden cemetery was designed to display the ideals of Andrew Jackson Downing and the Garden Cemetery Movement. Oak Hill may be "the best surviving A. J. Downing garden."

U.S. Botanic Garden

Location Address: **(202) 225-7099**
Maryland Ave., SW **Mailing Address:**
245 First St., SW
Washington, D.C. 20024

Hours: every day 9–5; June–Aug. 9–9.
Admission: no fee.
Directions: at the foot of Capitol Hill facing Maryland Ave., SW; follow exit signs on

I–295 or I–395 to the U.S. Capitol.
Public Transportation: accessible by public bus and the orange and blue subway lines.

The U.S. Botanic Garden houses a living collection of 2,000 kinds of tropical, subtropical and desert plants. The Botanic Garden is a part of the Federal Government, under the jurisdiction of the Joint Committee of the Library of Congress.

The series of 10 houses, connected to form the rectangular conservatory complex of 29,000 sq. ft., includes the Cactus, Bromeliad, Fern, Cycad and Subtropical Houses. The tallest, the Palm House, stands at the center of the complex. Orchids are displayed in the Subtropical House, with 200 to 300 blooming plants on display continuously. Most of the houses are landscaped with rocks and display the plants in a naturalistic manner.

United States National Arboretum

Agricultural Research Service (202) 472-9279
U.S. Department of Agriculture
3501 New York Ave. NE
Washington, D.C. 20002

Hours: weekdays 8–5; weekends and holidays 10–5; closed Dec. 25.
Admission: no fee.
Directions: located in the northeast section of Washington, D.C. Take Maryland Ave. from the Capitol to Bladensburg Rd., then to New York Ave. Visitor entrance is located on New York Ave. NE.
Public Transportation: from central Washington, accessible by Metrorail or bus; call (202) 637-2437.

The National Arboretum's 49,000 plant accessions are maintained on 444 acres along the Anticostia River. Plants from a wide range of climates are grown, adding to the Arboretum's national character. Research activities involve plant introduction, breeding, selection and distribution. The Science and Education Administration, Department of Agriculture, administers the Arboretum.

Nine miles of roads connect single-genus collections, such as hollies (700 species and cultivars), crabapples (about 500 kinds), crape myrtle, dogwood (70 kinds), pyracantha, magnolias, cherries, irises, viburnums and maples. Boxwood, daylilies and peonies are planted in formal-garden settings. Plantings of 70,000 azaleas, among the most extensive in the nation, include a number of hybrid groups: Glenn Dale, Kurume, Kaempferi, Ghent, Mollis and Knapp Hill.

The Gotelli Collection of dwarf and slow-growing conifers contains over 1,500 plants covering five acres and representing 30 genera. Naturalistic plantings of ferns and other plants native to eastern North America can be seen in Fern Valley, while Cryptomeria Valley features a collection of Oriental plants. Exhibited in an enclosed pavilion near the Administration Building is a priceless display of 53 bonsai, given to the United States by the Nippon Bonsai Association of Japan.

The National Herb Garden covers about two acres and is divided into three sections: the Knot Garden, the historic Rose Garden and the Specialty Gardens. The three-acre National Country Garden displays 13 small gardens appropriate for city dwellers. Also of interest are the 24 sandstone capitol columns, in a setting designed by the late Russell Page, the well-known British landscape artist.

In 1927 Congress approved a bill directing the Secretary of Agriculture to establish an arboretum. The first major planting was installed in 1947–48. The historical significance of the Arboretum was recognized in 1973, when it was placed on the National Register of Historic Places.

Florida

Cypress Gardens

Public Relations Dept. **(800) 282-2123**
P.O. Box 1 **Nationwide**
Cypress Gardens, **(800) 237-4826**
FL 33880 **in Florida**

Hours: every day 8–sunset.
Admission: fee charged.

Directions: 45 miles southwest of Sea World on St. Rd. 540 east, midway between Tampa and Orlando.

Cypress Gardens opened in 1936 on 16 acres of reclaimed swampland. The Gardens have grown to 223 acres and feature tropical and subtropical foliage, a waterskiing show, a zoological park and a swimming and high-diving water spectacular. Over 8,000 varieties of plants (70 percent subtropical and 30 percent tropical) are represented.

The botanical gardens are divided into two main areas: the Original Gardens, the 16-acre tract opened to the public in 1936, and Gardens of the World, offering floral and architectural salutes to foreign countries.

Thomas Edison Winter Home and Botanical Gardens, Fort Myers, Florida.

Thomas Edison Winter Home and Botanical Gardens

2350 McGregor Boulevard **(813) 334-3614**
Fort Myers, FL 33901

Hours: Mon.–Sat. 9–4; Sun. 12:30–4; closed Dec. 25 and Thanksgiving Day.
Admission: fee charged.
Directions: within 1 mi. of downtown Fort Myers; follow directional signs to Edison Estate, leading from U.S. 41.
Public Transportation: accessible by Leetran Bus System.

The Edison Winter Home is a historic estate where the inventor's chemical laboratory, personal residence, botanical gardens and a memorabilia museum can be toured. The 14 acres of subtropical gardens and vintage buildings are maintained by the City of Fort Myers.

Thomas Edison (1847–1931) imported plants from all over the world and grew them at his southern home—not for their beauty, but for the products and by-products they were capable of yielding. Today, the Gardens contain over 1,000 species of plants experimented on by Edison. The cycads, palms and collection of Ficus Family plants are notable attractions.

In 1947 Mina Edison willed the estate to the City of Fort Myers, to be maintained in remembrance of her husband. The museum was completed in 1970.

Preston B. Bird and Mary Heinlein Fruit and Spice Park

24801 S.W. 187 Avenue **(305) 247-5727**
Homestead, FL 33031

Hours: every day 10–5; scheduled tour times: Sun. 1 and 3.
Admission: no fee.
Directions: located on Coconut Palm Dr. and Redland Rd. north of Homestead; take U.S. 1 to Princeton, turn west on Coconut Palm Dr. (248 St.); 5 mi. straight ahead to the Park.

Bok Tower Gardens

P.O. Drawer 3810 **(813) 676-1408**
Lake Wales, FL 33859-3810

Hours: every day 8–5:30.
Admission: fee charged.
Directions: near Lake Wales, 40 mi. from Orlando; signs on U.S. 27 and U.S. 60 direct visitors.

Edward Bok acquired land near Lake Wales in 1922 and dreamed of creating "a spot which would reach out its beauty to the people." Frederick Law Olmsted, Jr. was hired to help realize the dream and architect Milton B. Medary was engaged to design a carillon tower. President Calvin Coolidge formally dedicated the grounds and tower in 1929 as a gift from Bok to the American people.

About half of the Gardens' 130 acres are landscaped, with wide curving paths (bordered by ground covers), open vistas and plantings of azaleas, camellias, gardenias and magnolias against a background of ferns, live oaks, pines and a variety of palms. Over 300 kinds of cultivated plants are incorporated into the landscape.

Mirrored in the Reflection Pool is the focal point of the Gardens, the carillon Singing Tower. It is made of pink marble and coquina stone, soars 205 feet and houses 53 bronze bells which fill the Gardens with music daily. The tower is surrounded by a moat in which a variety of water plants, including iris and papyrus, is grown.

Bok Tower Gardens is managed by The American Foundation, a not-for-profit organization established by Bok in 1925.

Fairchild Tropical Garden

10901 Old Cutler Road **(305) 667-1651**
Miami, FL 33156

Hours: every day 9:30–4:30, except Dec. 25.
Admission: fee charged.
Directions: about 10 mi. southwest of downtown Miami on Old Cutler Rd.
Public Transportation: accessible by bus from Coral Gables.

Fairchild Tropical Garden, the largest tropical botanical garden in the continental U.S., is best known as an attractively landscaped display garden, but it also houses research facilities for studying tropical plants. The 83-acre Garden features about 5,000 different kinds of plants situated among eight lakes, winding paths and open vistas. It is owned and operated in association with the Metropolitan Dade County Park and Recreation Department.

The palm and cycad collections at Fairchild are among the world's finest and largest. Bromeliads, aroids, orchids, ferns and tropical flowering trees make up other outstanding collections. Plants native to the Everglades, the Florida Keys and the Bahamas are grown in areas simulating their natural habitats.

Originally organized to be a public facility, the Garden officially opened in 1938. It was the creation of Colonel Robert H. Montgomery, a federal tax authority and accountant whose hobby was plants. William Lyman Phillips designed the Garden and it is named after Dr. David Fairchild, the famous plant explorer who was a close friend and advisor to Col. Montgomery.

Vizcaya Museum and Gardens

3251 South Miami Avenue **(305) 579-2708**
Miami, FL 33129 **4626**

Hours: every day 9:30–5, except Dec. 25; ticket window closes at 4:30.
Admission: fee charged.
Directions: 10 mi. south of downtown Miami; signs posted on I–95.
Public Transportation: accessible by bus and Metrorail Rapid Transit.

Vizcaya, an American realization of an Italian-Renaissance villa and gardens, combines elements of Italian architecture, French and Italian garden design, ocean views and tropical vegetation. Industrialist James Deering employed 1,000 workers to build the estate during 1914–16. The house was opened as a decorative arts museum in a garden setting in 1952, after it was acquired by Dade County.

Leu Botanical Gardens

1730 Forest Avenue **(305) 894-6021**
Orlando, FL 32803

Hours: gardens, every day 9–5, except Dec. 25; house, Wed.–Sun. 10–1.
Admission: fee charged.
Directions: four mi. northeast of downtown Orlando, just off Hwy. 17 and 92; four blocks off Mills Ave. at Nebraska and Forest.
Public Transportation: accessible by bus.

The Four Arts Garden

Four Arts Plaza **(305) 655-2766**
Palm Beach, FL 33480

Hours: year-round, Mon.–Fri. 10–5; Nov.–Apr., Sat. 10–5; Jan. to mid-Apr., Sun. 2:30–5.
Admission: no fee.
Directions: cross the bridge from Okeechobee Blvd. into Palm Beach and onto Royal Palm Way; take the first left into Four Arts Plaza; garden is on the east side of plaza next to the library.

Marie Selby Botanical Gardens

800 S. Palm Avenue **(813) 366-5730**
Sarasota, FL 33577

Hours: every day 10–5, except Dec. 25.
Admission: fee charged.
Directions: on the waterfront in downtown Sarasota; Mound St. (Rt. 41) and S. Palm Ave.

View from House to south, Vizcaya Museum and Gardens, Miami, Florida (photo: Doris Littlefield)

At the Marie Selby Botanical Gardens, situated on a peninsula bordered by the Sarasota Bay and the Hudson Bayou, visitors can enjoy the waterfront and more than 10,000 different kinds of plants, including many epiphytes. A highlight is the display greenhouse (7,000 sq. ft.) containing a jungle of orchids, bromeliads, other epiphytes from tropical forests and hanging baskets of gesneriads. Further features include tropical food plants, hibiscus, the Cactus and Succulent Garden, the Herb Garden, a bamboo grove, banyan trees, a lily pond and waterfall, and a trellis area in front of the greenhouse with tropical vines and State-Champion *Ficus* species.

The Selby House, located at the center of the Gardens, became the winter home of Bill and Marie Selby in the 1920s. In 1972 Marie Selby bequeathed her home, gardens and a trust for the development of a botanical garden. The Gardens opened to the public in 1975.

Alfred B. Maclay State Gardens

3540 Thomasville Road **(904) 893-4232**
Tallahassee, FL 32308

Hours: park, every day 9–5; Gardens, winter to spring blooming season (Jan.–Apr.)
Admission: fee charged.
Directions: 5½ mi. north of Tallahassee and ¾ mi. north of I–10 on U.S. Hwy. 319 (Thomasville Rd.).

Busch Gardens

3000 Tampa Boulevard **(813) 971-8282**
Tampa, FL 33612

Hours: every day 9:30–6; summer and selected holidays 9:30–10.
Admission: fee charged.
Directions: 8 mi. northeast of downtown Tampa and 2 mi. east of I–75 and the Busch Blvd. interchange.

Busch Gardens is a 300-acre African-theme park, and many of the 3,000 animals displayed roam in naturalistic areas landscaped with appropriate plants.

Busch Gardens opened in 1959 on 15 acres of sandy waste land next to Anheuser-Busch's Tampa brewery. It attracts three million visitors annually.

Museum of Botany and the Arts, Marie Selby Botanical Gardens, Sarasota, Florida (photo: Bob Wands)

Georgia

The State Botanical Garden of Georgia

2450 South Milledge Avenue
Athens, GA 30605

Hours: every day 8–8; Visitor Center/Conservatory, every day 9–4:30, except Dec. 25; Callaway Building, every day 8–5.
Admission: no fee.
Directions: on South Milledge Ave., 1 mi. south of the Athens bypass southern terminus; from I–95 take U.S. 441 south to Athens; follow the bypass to South Milledge Ave.

On 293 acres The State Botanical Garden of Georgia aims to conserve rare and unusual

Piedmont species, identify useful landscape plants through display and collect taxonomic plant groups.

Native species are featured along the one-mile scenic Oconee River frontage, in the large flood plain, in the upland forests and in dramatic spring-fed, gorgelike ravines of the Garden. Cultivated sections include the rose garden, one-acre annual and perennial garden, wildflower garden and azalea-camellia garden. Viburnums, dogwoods, redbuds, magnolias and mountain laurels form other flowering displays. The Visitor Center/Conservatory complex, covering ½ acre, was completed in 1985. It houses a reception center, offices and 10,000 sq.-ft. conservatory.

Development of the Garden started in 1968 when the Plant Science faculty proposed the project. By 1972, the Garden's boundaries were established and the Friends of the University of Georgia Botanical Garden, Inc., was formed.

Atlanta Botanical Garden

P.O. Box 77246 **(404) 876-5858**
Atlanta, GA 30357

Hours: Mon.–Sat. 9–5; Sun. 12–5; Apr.–Oct. 9–8; closed Jan. 1, Dec. 25, Thanksgiving Day, July 4, Labor Day.
Admission: fee charged.
Directions: I–75/85, 14th St. exit, east to dead end at Piedmont Rd.; left three blocks to Prado Entrance into park; follow signs.
Public Transportation: accessible by MARTA bus.

This eight-year-old, 60-acre Botanical Garden in Piedmont Park includes six acres of Japanese, rose, herb, fruit and vegetable, annual and perennial, wildflower-research and native gardens. A newly built attraction, "Gardenhouse," opened in 1985 and the Conservatory under construction is scheduled to open in 1989.

Fernbank Science Center
Fernbank Greenhouse and Botanical Gardens

156 Heaton Park Dr. NE **(404) 378-4311**
(Science Center)
765 Clifton Rd. NE
(Greenhouse and
Bot. Gardens)
Atlanta, GA 30307

Hours: Gardens, Mon.–Fri. 8:30–5; Sun. 1–5; Greenhouse, Sun. only 1–5; both closed major holidays.
Admission: no fee for Gardens.
Public Transportation: accessible by MARTA bus.

The Fernbank Science Center uniquely combines a museum, woodland and gardens to "promote an understanding of the upward spirals of science and technology; and to communicate. . . the harmony and order of the natural world."

The Botanical Gardens have over 1,200 kinds of indigenous and exotic plants. Herbs, annuals, vegetables and bulbs are displayed in the trial display gardens. Roses are grown in the Official Test Garden. The Fernbank Forest represents an undisturbed example of the area's original vegetation. Greenhouses are tropical plant preserves.

The Fernbank Science Center was established in 1966 and is operated by the Dekalb County School System and Fernbank, Inc.

American Camellia Society Headquarters
Massee Lane Camellia Garden

P.O. Box 1217 **(912) 967-2358**
Fort Valley, GA 31030

Hours: building, Mon.–Fri. 9–4; weekends by appointment; Garden open every day.
Admission: donation accepted.
Directions: 5½ mi. south of Fort Valley on Rt. 49.

Twelve acres of gardens known as Massee Lane Camellia Garden surround the 18th-

Callaway Gardens, Pine Mountain, Georgia

century-style Headquarters building of the American Camellia Society. The structure houses the most extensive camellia library in existence.

Mr. D.C. Strother, the original owner and builder of Massee Lane Garden, donated his camellia garden, farm acreage and money to the American Camellia Society in 1965. He had started planting camellias in the 1930s.

Azaleas, pines, magnolias, crape myrtles and daylilies join the camellias in formal and informal settings. A large display greenhouse contains exotic plants and over 150 varieties of camellias.

Callaway Gardens

Pine Mountain, GA 31822 **(404) 663-2281**

Hours: winter months, every day 8–5; summer months, 7–6.
Admission: fee charged.
Directions: located about 75 mi. southwest of Atlanta on U.S. Hwy. 27.
Public Transportation: accessible by bus.

Callaway Gardens, adjacent to Pine Mountain Ridge, consists of nearly 14,500 acres (2,500 under intensive development and 4,000 open to the public). The institution was conceived and endowed by Cason J. Callaway, Sr. and his wife, Virginia Hand Callaway, in 1952. Today, the Gardens are owned and operated by the Ida Cason Callaway Foundation.

The Garden's major emphasis is the preservation of native flora. Thirteen miles of paved roads and four major trail systems (Holly, Rhododendron, Azalea and Wildflower) allow visitors access to much of the acreage and intensive plantings. The five-mile Scenic Drive circles Mountain Creek Lake and connects the following: the Azalea Area (about 20 acres), displaying over 600 species and varieties; the Native Flora Area; the Laurel Springs Area, the most natural and undisturbed portion of the Gardens; the Greenhouse and Flower Garden Area (20,000 sq. ft.), containing seasonal floral displays and special collections; the Meadow Lake Area, with over 475 species and varieties of holly; and Mr. Cason's Vegetable Garden — 7½ acres laid out in a semicircle and demonstrating intensive fruit and vegetable culture on a grand scale.

Another major aspect of Callaway Gardens is the summer recreational area: a water-skiing pavilion, circus area, cottage area and three 18-hole golf courses, all centered around Robin Lake.

Hawaii

Waimea Arboretum and Botanical Garden

Waimea Falls Park **(808) 638-8511**
59-864 Kamehameha Highway
Haleiwa, HI 96712

Hours: every day 10–5:30.
Admission: fee charged.
Directions: 35 mi. from Honolulu, on the north shore at Waimea Bay, just past Haleiwa.
Public Transportation: Honolulu City Bus stops near entrance.

In the 1,800-acre nature park of Waimea Falls, named for the 45-foot waterfall, over 30 different botanical collections, set among steep valley walls, form the Arboretum and Botanical Garden. About 5,000 kinds of plants can be seen on the 150 acres open to the public. The emphasis is on threatened tropicals and collections include geographic floras of Guam, Bermuda, the Canary Islands, Malaysia, Central and South America and the Mascarene Islands. Many Hawaiian plants are also preserved. The Arboretum has the "world's finest collection" of gingers and heliconias and extensive displays of spider lilies, erythrina and hibiscus.

Foster Botanic Garden

180 N. Vineyard Boulevard **(808) 533-3406**
Honolulu, HI 96817

Hours: every day 9–4, except Dec. 25 Jan. 1.
Admission: fee charged.
Directions: in downtown Honolulu.
Public Transportation: accessible by bus.

Foster Botanic Garden, a 20-acre site, is the headquarters for the Honolulu Botanic Gardens, a development totaling 650 acres. Foster Botanic Garden started in 1855 when Queen Kalama sold the property to William Hillebrand who planted many of the trees that now tower over the Garden. Captain and Mrs. Thomas Foster acquired the site in 1867 and continued its development until 1930 when they bequeathed 5½ acres to the City of Honolulu as a public botanical garden. Today, 10,000 native and imported plants are displayed on the expanded site. Palms, orchids (10,000 hybrids), aroids, cycads, heliconias, bromeliads and economic plants are highlights of the collections.

Other gardens in the Honolulu Botanic Garden System:

Wahiawa Garden (1396 California Ave., Wahiawa, 96786):

The cool, humid climate of this site offers displays of tree ferns, palms, anthuriums, aroids, philodendrons, aralias and other tropical species. The 27-acre wooded gulch was used by the Hawaiian Sugar Planters' Association for forestry experiments and as a nursery in the 1920s. In 1950 it was turned over to the City for use as a public garden.

Koko Crater Botanic Garden:

At the eastern end of Oahu, this 200-acre site features dry-land plants.

Ho'omaluhia Botanic Garden:

This 400-acre, high-rainfall site at the foot of the Kane'ohe pali opened to the public in 1982.

Waimea Arboretum and Botanical Garden, Haiweia, Hawaii (photo: Nicki Clancey)

Harold L. Lyon Arboretum

University of Hawaii **(808) 988-3177**
3860 Manoa Road
Honolulu, HI 86822

Hours: Mon.–Fri. 9–3, except on state and federal holidays.
Admission: no fee.
Directions: at the end of Manoa Rd.
Public Transportation: accessible by City Bus #5.

Lyon Arboretum, a unit of the University of Hawaii at Manoa, contains 8,500 plant accessions on 124 acres (10 open to the public).

Among featured collections are the Hawaiian Ethnobotanical, Taro Cultivar and Economic Plant. The Arboretum includes outstanding displays of exotic tropicals and plants endemic to Hawaii in natural and landscaped areas. The successive elevations, from 350 to 1,600 feet, provide visitors with fascinating vistas and examples of varying microclimates.

The site was first developed as a Sugar Planters' Experiment Station in 1918.

Olu Pua Botanical Garden and Plantation

Box 518 **(808) 332-8182**
Kalaheo, Kauai, HI 96741

Hours: Mon., Wed. and Fri. 9–1:45.
Admission: fee charged.
Directions: located just past Kalaheo, in the direction of Waimea Canyon on Hwy. 50.

A collection of over 4,000 native and introduced tropical and subtropical fruits, flowers and trees occupies the 12 acres of Olu Pua Garden.

Sections include: the Palm Garden; the Jungle, where paths are darkened with swamp mahogany and other tropical trees laden with bromeliads, anthuriums and vanilla orchids; and the Kua Kua (food) Garden, where visitors may picnic amid tropical herbs and fruit trees. Various parts of the Garden are devoted to plants native to Kauai, and a highlight of the facility is its display of hibiscus hybrids.

The grounds were once part of the estate for the plantation manager of the Kauai Pineapple Company. Still privately owned, the Garden opened to the public in 1968.

Garfield Park Conservatory

300 N. Central Park Blvd. **(312) 533-1281**
Chicago, IL 60624

Hours: every day 9–5; during major shows, Mon.–Thurs. 10–6, Fri. 9–9.
Admission: no fee.
Directions: in Chicago, ½ block north of Lake St. on North Central Park Blvd.; 3600 West and 300 North.
Public Transportation: Chicago Transit Authority buses and L Train stop nearby.

The Garfield Park Conservatory consists of 4,800 types of plants on 4½ acres under glass. The outstanding collections, displayed in naturalistic settings within massive conservatory rooms, include Palms, Ferns and Cycads (some over 100 years old), Cacti and Succulents, Aroids (Arum Family) and Economic Plants. While these displays are permanent, two Conservatory rooms are reserved for seasonal shows.

The first glass house was built in 1893 and more facilities were added later.

Lincoln Park Conservatory

Stockton Drive and **(312) 294-4770**
Fullerton Parkway
Chicago, IL 60614

Hours: every day 9–5; during major shows, 10–6, Fri. 9–9.
Admission: no fee.
Directions: Lake Shore Dr. to Fullerton Pkwy.; one block west to Conservatory.
Public Transportation: CTA Routes: 151 Sheridan, 156 LaSalle, 22 Clark, 36 Broadway, 73 Armitage.

Erected during 1891-2, Lincoln Park Conservatory is an impressive Victorian installation, consisting of four glass buildings, 18 propagation houses, cold frames and hotbeds, covering three acres in all. The four conservatories are the Palm House, Fernery, Tropical House and Show House where four major displays are mounted annually. Outdoors, two flower gardens offer annuals and perennials.

Ladd Arboretum

2024 McCormick Boulevard **(312) 864-5181**
Evanston, IL 60201

Hours: grounds, every day dawn-dusk; Ecology Center and solar greenhouse complex, Tues.–Sat. 9–4:30.
Admission: no fee.
Directions: three mi. north of Chicago; McCormick Blvd. can be reached from the Edens Expwy. (I-94) by taking the Dempster St. exit and traveling east.

Ladd Arboretum, on the banks of the North Shore Channel, is a 23-acre landscaped strip with trees and shrubs arranged according to their plant families (Birch, Legume, Maple, Oak and Pine). Gardens include the Meadow, Prairie Restoration, Cherry Tree Walk, Nut Tree, Rotary International Friendship (with All-America Selections roses), Women's Terrace, Gazebo and Bird Sanctuary. At the hub of the installation is the Ecology Center, with a passive solar greenhouse (985 sq. ft.) attached.

Developed by means of private funding, the Arboretum officially opened to the public in 1960.

Chicago Botanic Garden

Lake Cook Road **(312) 835-5440**
P.O. Box 400
Glencoe, IL 60022

Hours: grounds, every day 8:30–sunset.
Admission: no fee; parking fee charged.
Directions: about 22 mi. north of Chicago Loop on Edens Expwy. (I-94); exit Lake Cook Rd. East; Garden is ¼ mi. from Edens Expwy.

The Chicago Botanic Garden, built on a marshy flood plain, is now a series of islands, lakes and waterways — a 300-acre site with 2,300 kinds of plants.

The main island hosts the Rose Garden (100 varieties) and the Linnaeus Heritage Garden which demonstrates the systematic classification of plants. The Fruit and Vegetable Island displays new varieties in various demonstration gardens. At the east end of the facility, a group of three islands form Sansho-en, a Japanese-style landscape with a dry garden, moss garden and viewing pavilions. At the south end of the Garden, are the Home Landscaping Center (with small gardens appropriate for patios), the Children's Vegetable Gardens and the Learning Garden for the Disabled. Across the water lies a prairie planting. Native plants can be seen in Trees of Illinois, containing 110 species, and in Turnbull Woods, 15 undisturbed acres.

At the hub of the largest island is the Educational Center, completed in 1976. Attached to this facility are ten greenhouses (9,000 sq. ft.) containing cacti, succulent, orchid, fern, gesneriad and other tropical-plant displays. Outside the building is the Trial and Display Garden where more than 10,000 annuals (200 varieties) are grown.

The Chicago Horticultural Society was formed in 1890, and it began building the Chicago Botanical Garden in 1965.

Morton Arboretum

Route 53 **(312) 968-0074**
Lisle, IL 60532

Hours: every day, weather permitting; standard-time period, 9–5; daylight-saving-time period, 9–7; Visitor Center, Apr.–Nov., Mon.–Sat. 9:30–5, Sun. 12–5; Dec.–Mar., Mon.–Sat. 9:30–4, Sun. 12–4.
Admission: fee charged.
Directions: 25 mi. west of downtown Chicago; just north of East-West Tollway (St. Hwy. 5) on Rt. 53.
Public Transportation: accessible by RTA trains to Lisle and Glen Ellyn.

Morton Arboretum was founded as an outdoor museum, with plants arranged conveniently for study. The collection includes nearly 4,000 types of specimens.

The Arboretum is organized according to landscape, geographic, habitat and botanical groups. Landscape displays, subdivided according to function, include: The Hedge Garden, with sheared hedges of over 100 kinds of trees and shrubs; the Tree Evaluation Plot, containing 83 kinds of trees, with five of each type arranged in rows to show how they might appear as street plantings; the Ground Cover Garden, containing woody plants, herbaceous perennials and annuals; the Colored Foliage Collection; the Shrub Collection (35 acres); the Dwarf Beds; and Columnar Trees.

The geographic groups include the Korean, Balkan (Southeast Europe), Caucasian (Central and West Asia), Central European Forest, Chinese and Japanese. American geographic groups being developed comprise Eastern U.S., Wetlands, Appalachian, Native Woody Plants of Northern Illinois, Pacific Northwest, Rocky Mountains, Plains, Southwest and the Ozarks.

There are also two special habitat groups: the Sand Beds, with sand as topsoil, and the Cool Garden, located below a pond and dam installed with plants intolerant of drought.

Joy Morton (1855-1934), founder of Morton Salt Company, started the Arboretum in 1922 on the grounds of his estate.

The Oak Park Conservatory

Parks and Recreation **(312) 386-4700**
Department of Oak Park
1 Village Hall Plaza
Oak Park, IL 60302

Hours: Mon. 2–4, Tues.–Sun. 10–4; closed Thanksgiving Day and Dec. 25.
Admission: no fee.
Directions: located 10 mi. west of the Chicago Loop, on Garfield St. between the Harlem-Ave. and Austin-Blvd. exits of I-290.

Glen Oak Botanical Garden

Peoria Park District **(309) 685-4321**
2218 N. Prospect Road
Peoria, IL 61603

Hours: grounds, every day dawn–dusk; conservatory, every day 8–4.
Admission: no fee.
Directions: I–74 to Peoria; Knoxville Ave. exit to McClure Ave., turn right and continue to main entrance of Glen Oak Park; Garden at intersection of Prospect Rd. and McClure Ave.
Public Transportation: accessible by bus.

Washington Park Botanical Garden

Location address:
Washington Park
Fayette and
Chatham Rds.
Springfield, IL 62704

Mailing address:
P.O. Box 5052
Springfield, IL 62705

Hours: Mon.–Fri. 12–4, Sat. and Sun. 12–5.
Admission: donation requested.
Directions: from I–55 take South Grand exit; South Grand west to Washington Park; proceed through park, following signs.
Public Transportation: accessible by city bus.

Education Center and greenhouses, Chicago Botanic Garden, Glencoe, Illinois

Indiana

Hayes Regional Arboretum

801 Elks Rd. **(317) 962-3745**
Richmond, IN 47374

Hours: Apr. 15 to Nov. 31, Tues.–Sat. 8–5, Sun. 1–5; Dec. 1 to Apr. 14, Tues.–Sat. 8–5; closed Mon.
Admission: no fee.
Directions: located 3 mi. west of the Indiana-Ohio border; take U.S. 40 west exit from I–70; travel 2½ mi. to entrance.

Iowa

Bickelhaupt Arboretum

340 South 14th St. **(319) 242-4771**
Clinton, IA 52732

Hours: every day dawn–dusk.
Admission: no fee.
Directions: 20 mi. north of the junction of I–80 and Rt. 67; in the center of Clinton.
Public Transportation: accessible by city bus (stop 2 blocks away).

Des Moines Botanical Center

909 East River Dr. **(515) 283-4148**
Des Moines, IA 50316

Hours: Mon.–Thurs. 10–6, Fri. 10–9, weekends 10–5; closed Thanksgiving Day, Dec. 25 and Jan 1.
Admission: fee charged.
Directions: located on the east bank of the Des Moines River between the University Ave. bridge and the MacVicar Frwy. (I–235) bridge; from I–235 take the East 6th St. exit.

Kansas

The Bartlett Arboretum

Box 39 **(316) 488-3451**
Belle Plaine, KS 67013

Hours: Apr. 1 to mid-Nov., every day 9–6.
Admission: fee charged.
Directions: 20 mi. south of Wichita on Hwy. 55.

The Bartlett Arboretum was started in 1910 by Dr. Walter E. Bartlett. The 20-acre tract of wooded gardens represents the "only arboretum of maturity between the Mississippi River and the Rockies." The Arboretum contains trees, shrubs, grasses and flowers from all over the world, that tolerate the Kansas climate. The extensive formal garden includes courtyards, hedge-bordered beds, terraces, sunken areas and fountains.

Gage Park: Reinisch Rose Garden, Doran Rock Garden, Conservatory, Topeka Zoo

4320 W. 10th St. **(913) 232-1484**
Topeka, KS 66604

Hours: Rose Garden, every day 6–11; Conservatory, Mon.–Fri. 8–4:30, Sun. 2–4; Zoo, every day 9–5.
Admission: Gardens, no fee; Zoo, fee charged.
Directions: I–70 to Gage Blvd., south to 6th St.; right on 6th; left into Gage Park.
Public Transportation: accessible by bus from downtown.

Kentucky

Bernheim Forest, Arboretum and Nature Center

Clermont, KY 40110 **(502) 543-2451**

Administration Office, Cave Hill Cemetery
Louisville, Kentucky

Hours: Mar. 15 to Nov. 15, every day 9–sundown; Nature Center Museum closed Mon.
Admission: no fee.
Directions: 30 mi. south of Louisville on State Rd. 245 (2 mi. east of I-65).

Bernheim Forest is a preserve of 10,000 acres, 2,000 of which have been developed for educational and recreational uses. The Arboretum and Nature Center cover 250 acres. The landscaped Arboretum features 1,500 kinds of plants. Specialized collections include crabapples, nut trees, beech, ginkgos, oaks, horsechestnuts, buckeyes, dogwood, azaleas, viburnums, dwarf conifers and maples. The installation has been designated by the Holly Society of America as an official Holly Arboretum.

Bernheim Forest had its beginnings in 1928 when Mr. Isaac Wolfe Bernheim bought 14,000 acres of land for the purpose of conservation. The facility is owned and operated by the Isaac W. Bernheim Foundation.

Rosedown Plantation and Gardens, St. Francisville, Louisiana

Lexington Cemetery

883 West Main St. **(606) 255-5522**
Lexington, KY 40508

Hours: grounds, every day 8–5; special holidays until dusk; office, Mon.–Sat. 8–4, Sun. 1–4.
Admission: no fee.
Directions: about 1 mi. west of courthouse.

Cave Hill Cemetery

701 Baxter Ave. **(502) 451-5630**
Louisville, KY 40204 **584-8363**

Hours: every day 8–4:45.
Admission: no fee.
Directions: 3 mi. from I-64 at the Grinstead Dr. exit.

Louisiana

Hodges Garden

P.O. Box 900 **(318) 586-3523**
Many, LA 71449

Hours: Gardens, every day 8–sunset; greenhouses, spring–summer, every day 9–5; fall–winter 9–4:30; closed Dec. 24 25 and Jan. 1.
Admission: fee charged.
Directions: on Hwy 171, halfway between

Shreveport and Lake Charles; 12 mi. south of Many and opposite Toro Hills Resort.

Hodges Gardens, known as the "garden in the forest," began in the 1940s as a 4,700-acre experimental reforestation project headed by pioneer conservationist A.J. Hodges. A ten-mile drive circles the 225-acre lake at the heart of the Gardens. Points of interest around the lake include the Louisiana Purchase Memorial, natural areas and scenic overlooks, wildlife pastures, Lookout Tower, the conservatory and greenhouses (displaying tropical collections) and 60 acres of formal gardens with extensive plantings of tulips, dogwood and azaleas, annuals and roses. Abandoned stone quarries provide the Gardens with multi-level settings, and water pumped from the lake forms pools, waterfalls and streams.

Hodges Gardens was formally dedicated in 1959 and is owned and operated today by the not-for-profit Hodges Foundation.

Audubon Park and Zoological Garden

6500 Magazine St. **(504) 861-2537**
P.O. Box 4327
New Orleans, LA 70178

Hours: Mon.–Fri. 9:30–4:30, weekends 9:30–5:30; closed Thanksgiving Day, Dec. 25, Jan. 1 and Mardi Gras; other holidays 9:30–5:30.
Admission: fee charged.
Directions: from downtown New Orleans, take Magazine St. to Audubon Park.
Public Transportation: accessible by St. Charles streetcar and Broadway bus.

Longue Vue House and Gardens

7 Bamboo Rd. **(504) 488-5488**
New Orleans, LA 70124

Hours: Tues.–Fri. 10–4:30, Sat. and Sun. 1–5; closed Mon. and national holidays.
Admission: fee charged.
Directions: off I-10 Expwy. at Metairie-Rd. exit; a short distance from downtown New Orleans.
Public Transportation: accessible by Canal-Metairie Rd. buses.

Longue Vue House and Gardens is an eight-acre city estate built between 1939 and 1942 in the classical tradition. Its Gardens are influence by English and Spanish styles and contain examples of Greek-Revival architecture. The basic plan of the estate is a large formal garden, the Spanish Court, surrounded by a series of smaller plantings, each unique in color scheme and character. Throughout, a total of 25 fountains create a cooling effect and provide a unifying aquatic theme. Oaks, magnolias, camellias, azaleas, roses, sweet-olives, crape myrtles and oleanders are combined with seasonal floral displays.

Longue Vue was designed and built for Mr. and Mrs. Edgar B. Stern. In 1968, the year the estate opened to the public, Mrs. Stern established the Longue Vue Foundation to preserve and maintain the facility.

Rosedown Plantation and Gardens

P.O. Box 1816 **(504) 635-3332**
St. Francisville, LA 70775

Hours: Mar.–Oct., every day 9–5; Nov.–Feb., 10–4; closed Dec. 24 and 25.
Admission: fee charged.
Directions: 25 mi. north of Baton Rouge, via U.S. 61 or La. Hwy. 10.

Rosedown, a restored Southern manor (mansion and Gardens) with 2,400 acres of surrounding land, functions as an example of plantation life as it was before the Civil War. The mansion and 30-acre Gardens were begun in 1835, and many plants dte back to that time.

The avenue leading to the mansion is shaded by live oaks nearly 200 years old. Closer to the structure are both formal and utilitarian gardens: the Flower Garden, North Parterre, Eve's Garden, Herb Garden and Medicinal Herb Garden. Throughout the

grounds, plants have grown to maturity and express their natural character. The grove of century-old camellias, for example, is 25 feet tall. Mature azaleas, crape myrtles, sweet-olives and conifers are other featured plants. Sixteen rooms of the two-story mansion may be toured.

In 1956 Catherine Underwood of Houston, Texas, visited Rosedown just as the estate had been put on the market. Impressed with the original beauty of the gardens, she and her husband decided to buy the property, embarking on an eight-year restoration progrm. Catherine opened Rosedown to the public in 1964. Since her death in 1970, her family has continued to operate the site, now a division of Feliciana Corporation.

Japanese Teahouse, Brookside Gardens, Wheaton, Maryland

Maryland

William Paca House and Garden

1 Martin St. **(301) 269-0601**
Annapolis, MD 21401 **267-6656**

Hours: Garden, Mon.–Sat. 10–4; Sun., Nov.–Apr., noon–4; May–Oct., noon–5; closed Thanksgiving Day and Dec. 25; House, Tues.–Sat., 10–4, Sun. and holidays noon–4; closed Mon., Thanksgiving Day and Dec. 25.
Admission: fee charged.
Directions: Take Rowe-Blvd. exit from U.S. 50, left from Rowe onto College Ave., right on King George St.; entrance on Martin St.

William Paca, a signer of the Declaration of Independence and an early governor of Maryland, built his house and garden between 1765 and 1772. By 1900 the sadly neglected garden had been completely covered by a hotel, parking lot and bus depot.

When Paca's historic house was threatened in 1965, Historic Annapolis, Inc., a preservation group, acted to save the structure. Further efforts by the group led to the complete restoration of the colonial garden based on archaeological findings and evidence from paintings.

Today, the terraced and walled town Garden includes many native plants admired in the 18th century, heirloom garden perennials and old varieties of roses.

London Town Publik House and Gardens

839 Londontown Rd. **(301) 956-4900**
Edgewater, MD 21037

Hours: Tues.–Sat. 10–4; Sun. 12–4, closed Mon., Dec. 25, Thanksgiving Day, Jan. and Feb.
Admission: fee charged.
Directions: 7 mi. from Annapolis; take Rt. 2 south to Lee Airport in Edgewater; turn left onto Mayo Rd. (Rt. 253) and proceed 1 mi., turn left onto Londontown Rd.

London Town Publik House and Gardens is a National Historic Landmark maintained by

the Department of Recreation and Parks. The Publik House, dating to the middle of the 18th century, is the only remaining structure on the site of a once-thriving seaport town.

Eleven acres adjoining the Publik House and fronting South River feature native trees, shrubs and wildflowers. Along the winding paths, magnolias, hollies, cherries, viburnums, conifers, peonies and Japanese iris are displayed. The Gardens also serve as a testing facility for winter-hardy camellias. Specialty areas include the Winter Garden and Salt Marsh Walk. Near the Publik House, herbs and 18th-century crops are grown.

Garden development began in 1970, and the site opened to the public in 1972.

Ladew Topiary Gardens

3535 Jarrettsville Pike **(301) 557-9466**
Monkton, MD 21111

Hours: Gardens, mid-Apr. to Oct., Tues.–Fri. 10–4, Sat.–Sun. noon–5; Manor House, Wed., Sat., Sun. during garden hours or by special arrangement otherwise; open year-round for group tours by appointment.
Admission: fee charged.
Directions: on Rt. 146, 14 mi. north of I-695 (Baltimore Beltway) exit 27 north.

The House and Gardens of Ladew were developed as a private estate between 1929 and 1976. Harry S. Ladew restored and enlarged an old house (late 1700s) and furnished it with a mixture of styles. On 22 acres outdoors, he designed and developed 15 secluded gardens (surrounding a central bowl, terraces and allee) that are outlined by a third of a mile of tall sculptured hedges.

The topiary figures Ladew Gardens is famous for depict a huntsman and hounds chasing a fox, swans floating on undulating waves of yew, seahorses, lyre birds, a unicorn, giraffe, top hat, heart and arrow, Churchill's "V for Victory," a Chinese junk and a Buddha.

In creating his gardens, Ladew focused on specific themes. There are pink, yellow, red and white gardens, each filled with flowering plants that carry the color from spring through summer. Others include the Wild Garden, Victorian Garden, Berry Garden, Rose Garden, Garden of Eden (an apple orchard underplanted with azaleas, complete with a statue of Adam and Eve) Waterlily Garden, Iris Garden, Terrace Garden, Herb Garden (30 varieties of herbs) and Portico Garden.

Before Mr. Ladew died in 1976, he set up a foundation to run the Gardens and house. Both are in the National Register of Historic Places.

Brookside Gardens

1500 Glenallan Ave. **(301) 949-8230**
Wheaton, MD 20902

Hours: conservatories, every day 9–5; grounds, every day 9–sunset; closed Dec. 25.
Admission: no fee.
Directions: 10 mi. north of Washington, D.C.; from Beltway (495) take exit 31A (Rt. 97) north towards Wheaton; continue for 3 mi. to Randolph Rd. and turn right; right again at Glenallan Ave.; continue 3/4 mi.; Gardens are on the right.
Public Transportation: 10-minute walk from bus stop.

Established in 1969, Brookside Gardens, a 50-acre display garden, is operated by the Maryland National Capitol Park and Planning Commission.

A series of small gardens are connected by walkways and waterways. The Formal Gardens, three connected courtyards terraced on a hillside, feature perennials, annuals and flowering plum trees set off by fountains. In the Rose Garden over 600 plants (40 varieties) are grouped with evergreens, ornamental grasses and ground covers. In the Trial Garden, unusual plants and designs provide innovative ideas for the home gardener. Other areas include the Fragrance Garden, Viburnum Garden, Winter Garden, Azalea and Woodland Garden (7½ acres) Aquatic Garden and the Gude Garden where a Japanese-style pavilion

overlooks a lake and rolling hills. Conservatories cover 8,400 sq. ft. and feature year-round floral displays.

Massachusetts

Isabella Stewart Gardner Museum

2 Palace Rd. **(617) 566-1401**
Boston, MA 02115

Hours: Tues. 12–9 (July to Aug., 12–5); Wed.–Sun. 12–5; closed Mon. and national holidays.
Admission: fee charged.
Directions: from Mass. Tpk. take exit 22; Rt. 9 (Huntington Ave.) past Museum of Fine Arts to Longwood Ave.; right on Longwood, then right on Palace Rd.
Public Transportation: Museum–Ruggles stop by bus or train.

The Gardner Museum is the achievement of Isabella Stewart Gardner (1860–1924) who designed the building and endowed it to house her personal collection of about 2,000 art objects. Fenway Court, an indoor courtyard filled with plants, was designed in the style of a 15th-century Venetian palace.

Mount Auburn Cemetery

580 Mount Auburn St. **(617) 547-7105**
Cambridge, MA 02138

Hours: grounds, May 1 to Oct. 1, every day 8–7; rest of the year 8–5; office closed Sun. and holidays.
Admission: no fee.
Directions: on Rt. 16 at the Cambridge-Watertown boundary line.
Public Transportation: accessible by MTA.

Mount Auburn Cemetery, the first garden cemetery in America, has about 2,500 identified trees on its 170 acres. Over 350 different varieties are represented; many are over 100 years old with trunks exceeding three feet in diameter. Hilly terrain and three lakes add to the beauty of the grounds. In addition to the extensive tree collection, there are over 40,000 annual plants, 5,000 to 10,000 bulbs, beds of perennials and thousands of shrubs.

Started in 1831 by Dr. Jacob Bigelow and the Massachusetts Horticultural Society, the Cemetery/garden is owned by the Proprietors of the Cemetery of Mount Auburn.

Garden in the Woods of the New England Wild Flower Society

Hemenway Road **(617) 877-6574**
Framingham, MA 01701

Hours: Apr. 15 through Oct., Tues–Sun. 9–4.
Admission: fee charged.
Directions: Rt. 128 to Rt. 20 west; 7½ mi. to Raymond Rd.; 1.3 mi. to Hemenway Rd.

Garden in the Woods consists of 45 acres of rolling hills, woodlands, ponds, brooks, trails and wildflowers, and includes the largest (15 acres) landscaped collection of northeastern native plants (1,500 species and varieties). The Garden is owned and operated by the New England Wild Flower Society (NEWFS) whose purpose is education and research in native-plant conservation, botany, ecology and horticulture.

Trails wind through a number of specialty gardens: Western, Meadow, Sunny Bog, Lily Pond, Lady's-Slipper Path and Rich-Woodland Groves. Also featured is a 1,000-sq.-ft. solar greenhouse.

W.C. Curtis and H. Stiles began the subtle landscaping in the 1930s, but it continues to be developed and refined by NEWFS.

The Arnold Arboretum, Jamaica Plain, Massachusetts (photo: C. Lobig)

The Arnold Arboretum

Jamaica Plain, MA 02130 **(617) 524-1718**
524-1717
(recorded info.)

Hours: every day, sunrise–sunset.
Admission: no fee; donations accepted.
Directions: located on the Arborway, 12 mi. south of downtown Boston, near the junction of Rts. 1 and 230.
Public Transportation: accessible by Forest Hills Subway (Orange Line) or the Arborway car or bus.

Over 7,000 varieties of ornamental trees and shrubs from all over the North Temperate Zone are planted throughout The Arnold Arboretum. An affiliate of Harvard University and a part of the Boston Park System, it serves the local community as a 265-acre oasis of nature.

The Arboretum is divided into several general areas, each featuring a number of different kinds of plants, many old and noted specimens. One area is devoted to leguminous trees; another features shrubs and vines, from barberries to wisterias. In the meadow, native wildflowers grow among willows and flowering shrubs. Along the Chinese Path are arrangements of Asiatic plants, including many of the original introductions from China. On Hemlock Hill, numerous rhododendrons, azaleas and mountain-laurels are shaded by a canopy of natural woods. Other sizeable and notable collections include lilacs, crabapples, conifers, dwarf conifers, maples and viburnums. Bonsai are displayed in a pavilion near the Dana Greenhouses.

Established in 1872, the Arnold Arboretum is the oldest public arboretum in America, and its history is laced with prominent horticultural figures. Charles Sprague Sargent, the first director of the Arboretum, collaborated with Frederick Law Olmsted in designing the grounds. Most of Olmsted's original plan has been maintained. E.H. "Chinese" Wilson, the famous plant explorer, also served on Arnold's staff.

The Botanic Garden of Smith College

Lyman Plant House **(413) 584-2700**
Northampton, MA 01063 **ext. 2748**

Hours: grounds, every day at all times; greenhouses, every day 8–4.
Admission: no fee.
Directions: north of Springfield; take exit 19 from I–91; left onto Rt. 9 north and continue through Northampton to College La.; left on College La., one block to greenhouse.

The teaching of botany and horticulture, a part of Smith College since the 1880's, has been facilitated over the years by a series of campus greenhouses and gardens. These now contain over 3,500 kinds of plants.

The Lyman Plant House, a conservatory built in 1896 and expanded a number of times from 1902 to 1981, is a major horticultural attraction. Individual sections include: Warm Temperate House; Stove House, with an aquatic tank, orchids and bromeliads; Cold Storage House, where bulbs and spring flowers are forced each year; Temperate House; Palm House; Fern House; Cold Temperate House; Succulent House; and Show House.

The whole campus, dotted with mature woody plants, serves as an arboretum. The original plan, laid out in 1895 by Frederick Law Olmsted, called for the entire grounds to function as a botanical garden, with plant materials selected and arranged both for aesthetic and scientific purposes. Herbaceous gardens and a rock garden are adjacent to the conservatory. Other areas of interest on the campus are the Capen Gardens, with formal beds of tulips and annuals, and the President's House featuring a terraced rose garden and an herb garden.

Heritage Plantation of Sandwich

Grove St. **(617) 888-3300**
Box 566
Sandwich, MA 02563

Hours: mid–May to mid–Oct., every day 10–5.
Admission: fee charged.
Directions: 3 mi. from Cape Cod Sagamore Bridge; Rt. 130 to Pine St. and the Museum.
Public Transportation: train, connecting to shuttle bus.

Seventy-six acres of landscaped grounds, flower beds and nature trails, featuring over 1,000 kinds of trees, shrubs and flowers, surround Heritage Plantation, a museum of diversified Americana. The site was once the property of Charles O. Dexter, known for hybridizing rhododendrons. Horticultural highlights include thousands of Dexter rhododendrons and over 550 varieties of daylilies. The Plantation opened to the public in 1969.

Berkshire Garden Center

Box 826 **(413) 298-3926**
Stockbridge, MA 10262

Hours: mid-May to mid-Oct., every day 10–5.
Admission: fee charged.
Directions: located on both sides of Rt. 102, 2 mi. west of Stockbridge, just past the intersection of Rts. 102 and 183.
Public Transportation: Berkshire Regional Transit.

With the Berkshire Hills as a backdrop, this 15-acre Garden, started in 1934, features daylilies and other perennials, primroses, conifers and shrubs. In addition to various intimate landscaped areas, highlights include herb, flower and rose gardens, pond area and edible landscape (with herbs and vegetables grown in raised beds). Three kinds of greenhouses may be toured.

Naumkeag

The Choate Estate **(413) 298-3239**
Stockbridge, MA 01262

Hours: Sat. of Memorial Day through Mon. of Columbus Day, weekends and Mon. holidays; last Tues. in June through Mon. of Labor Day, everyday except Mondays.
House Tours, 10–4:15
Gardens, 10–5
Admission: fee charged.
Directions: on Prospect Hill off Main St. in Stockbridge.

Old Sturbridge Village

Sturbridge, MA 01566 **(617) 347-3362**

Hours: Apr.–Oct., every day 9–5; Nov.–March 10–4; closed Mon. (during winter), Dec. 25 and Jan 1.
Location: Rt. 20 west in Sturbridge; Mass. Tpke. (Rt. 90), exit 9; I-84, exit 3.
Public Transportation: Peter Pan Bus lines from Springfield and Boston; Amtrak trains from New York and Boston to Worcester.

Old Sturbridge Village is a living-history museum that recreates a New England town of the 1830s. Covering 200 acres and containing 40 restored buildings, the attraction includes people in historical dress demonstrating the life, work and community festivities of 19th-century New Englanders.

Horticultural highlights are the Herb Garden exhibit (300 varieties), door-yard gardens and formal gardens. Kitchen gardens offer early 19th century vegetable varieties, and fruits and field crops typical of the period are also grown.

In 1986 Old Sturbridge Village celebrated its fortieth year as a public attraction.

The Margaret C. Ferguson Greenhouses, Alexandra Botanic Garden, and Hunnewell Arboretum, Wellesley College

Central St. **(617) 235-0320**
Wellesley, MA 02181 **ext. 3074**

Hours: every day 8:30–4:30.
Admission: no fee.
Directions: greenhouses are behind the Science Center off College Road.

Walter Hunnewell Pinetum

845 Washington St. **(617) 235-0422**
Wellesley, MA 02181

Hours: Mon.–Sat. 8–6, by appointment only.
Admission: no fee.
Directions: on Rt. 16, between Wellesley and South Natick.

The Walter Hunnewell Pinetum was founded in 1852 by H.H. Hunnewell, and although it is still private, the grounds have always been open to the public. The outstanding features of the 39-acre property include rhododendrons and azaleas, topiaries and a conifer collection offering many mature specimens. Also of interest is an 18-section Victorian conservatory (about half of it in active use) housing an orchid collection.

The Stanley Park of Westfield, Inc.

400 Western Ave. **(413) 568-9312**
P.O. Box 1191
Westfield, MA 01085

Hours: every day 8–dusk from Mother's Day to Columbus Day. Recreation facility open year-round
Admission: no fee.
Directions: Park entrances on Kensington and Western Aves.
Public Transportation: accessible by bus.

Horticultural attractions in the 200-acre Stanley Park include a formal rose garden, Japanese garden, a five-acre arboretum and a rhododendron display garden. The Park was founded in 1945.

The Case Estates of the Arnold Arboretum

Location:	**Mailing Address:**
135 Wellesley St.	**The Arnold Arboretum**
Weston, MA 02193	**Jamaica Plain, MA 02130**
	(617) 524-1718

Hours: every day 9–sunset.
Admission: no fee.
Directions: 13 mi. from the Arnold Arbore-

tum; from Rt. 20 west take left onto Wellesley St.; from Rt. 90, exit Rt. 30–Weston; take 30 west for 2.5 mi., turn right onto Wellesley St., proceed 1 mi.

The Case Estates, on a 75-acre suburban site, serves as nursery and experimental station for the Arnold Arboretum. Areas of interest include ground-cover plots (140 types), Rhododendron Display Garden, Perennial Garden (emphasizing native-American plants) and collections of hosta, daylilies, iris and peonies.

The Arnold Arboretum was left this property in 1944 by sisters Louisa and Marian Case. The estate had been used for over 30 years by Marian Case as the setting for her school of agriculture and gardening.

Michigan

Matthaei Botanical Garden

University of Michigan **(313) 764-1168**
1800 North Dixboro Rd.
Ann Arbor, MI 48105

Hours: grounds, every day sunrise–sunset; Conservatory, 10–4:30; gift shop, the first full weekend of each month; closed Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: fee charged.
Directions: take the Geddes exit off U.S. 23; turn right on Geddes and left on Dixboro; Garden is within 100 yards.

The Matthaei Botanical Garden, encompassing 250 acres, displays a collection of 3,500 kinds of plants. The conservatory, the highlight of the Garden, consists of three houses covering 13,000 sq. ft. Each house encloses a distinct climate, bringing together plants from tropical, temperate and desert areas.

Much of the tract outdoors is maintained as natural habitats: bogs, ponds, streams, flood plain, upland forest and meadow. More than 700 species of native plants can be seen along winding trails. Other naturalistic areas are the Woodland Garden and prairie. Centered around the Conservatory are the Medicinal and Herb, the Rose and Perennial and the Rhododendron and Heath Gardens.

Cranbrook House and Gardens

380 Lone Pine Rd. **(313) 645-3149**
P.O. Box 801
Bloomfield Hills, MI 48013

Hours: May, every day 1–5; June–Aug., Mon.–Sat. 10–5, Sun. 1–5; Sept., every day 1–5; Oct., weekends only, 1–5.
Admission: fee charged.
Directions: from Detroit take Woodward Ave. to Lone Pine Rd.; from the north or Chicago, follow U.S. 24 (Telegraph Rd.) to Lone Pine Rd.

The charm of the early 1900s and the personalities of the Booth family can still be felt at Cranbrook House and Gardens. The Mansion, built in 1908, was designed by the prominent architect Albert Kahn; 40 acres of gardens surround it. The estate is now an adjunct of the Cranbrook Educational Community.

In addition to mature trees, outstanding vistas and rolling hills, a variety of planted areas are offered at Cranbrook: the Greek Theater features stone seats and a turf stage; Pine Hill Cascade, a line of decorative stepped basins, carries water to a series of pools. Cen-

Hidden Lake Gardens, Tipton, Michigan

tered around the House are three landscaped levels: the Library Garden, sporting English sculpture; the Promenade, leading to the Reflecting Pool, and the Bog, a naturalized site. On the North Terraces, flower beds line brick paths and stone walls. Turtle Fountain graces the Circular Terrace.

Anna Scripps Whitcomb Conservatory

Belle Isle Park **(313) 267-7133**
Detroit, MI 48207

Hours: every day 9–6
Admission: no fee.
Directions: located 2 mi. east of downtown Detroit on Belle Isle in the Detroit River; take Jefferson Ave. to E. Grand Blvd., across the MacArthur Bridge.
Public Transportation: accessible by bus.

Frederick Law Olmsted created the original master plan for Detroit's Belle Isle Park in 1883. The Whitcomb Conservatory, situated in the city-owned Park, was completed in 1904 and rebuilt in 1955, with its Victorian character maintained. The massive Palm House is filled with towering tropicals that can grow as tall as 85 feet before touching the structure's highest point. Other collections include orchids, southwest-American plants and ferns. Six major flower displays are staged annually in the Show House.

Formal gardens surrounding the Conservatory provide horticultural interest outdoors. These plantings, together with the Victorian glass house, cover about ten acres of the 1,000-acre Park.

W.J. Beal Botanical Garden and MSU Campus

Michigan State University **(517) 355-0348**
East Lansing, MI 48823

Hours: every day dawn-dusk.
Admission: no fee.
Directions: on MSU campus; East Circle Dr., off Collingwood Entrance from East Grand River.

The W.J. Beal Botanical Garden, started in 1873, is a five-acre installation with about 5,500 species of plants organized according to economic, systematic, landscape and ecological classifications. On two-and-a-half acres of the 5,200-acre campus are the Horticulture Gardens, displaying All-America Selections annuals (800 species) and roses. In addition, plantings are dispersed throughout the campus, with several genera assembled at specific locations.

Founded in 1855, MSU is recorded as being the nation's first land-grant university and as having the first horticulture department; this was established by the eminent Liberty Hyde Bailey.

Dow Gardens

1018 W. Main St. **(517) 631-2677**
Midland, MI 48640

Hours: every day 10–sunset; closed Thanksgiving Day, Dec. 24, 25, 31 and Jan. 1.
Admission: fee charged.
Directions: entrance is on the corner of Eastman Rd. (Business Rt. 10) and W. St. Andrews Rd., about 2 mi. south of U.S. 10; exit on Eastman Rd.; Gardens are adjacent to Midland Center for the Arts.

Dow Gardens, once the estate of Herbert H. Dow, founder of Dow Chemical Company, constitutes 65 acres of landscaped and naturalistic areas. Bulbs, annuals, perennials, wildflowers and over 800 types of woody plants form displays that "exhibit a composition of man with nature."

Notable collections of crabapples, pines, junipers, rhododendrons and other ericaceous plants are interspersed among numerous flower displays. Additional features include: Herb Garden, Native Wildflowers, Perennial Border, Rose Garden, Sensory Trail, All-America Display Garden, Test Bedding Plant Area (300 species and/or cultivars). Punctuating the landscape are statuary, picturesque

bridges, streams, waterfalls, pools with aquatic plants, lakes and a display greenhouse (3,000 sq. ft.)

The Gardens were started in 1899 for the enjoyment of friends and associates of the Dow family. Today, the institution is an agency of the Herbert H. and Grace A. Dow Foundation.

Fernwood

1720 Range Line Rd. **(616) 695-6491**
Niles, MI 49120 **or 6688**

Hours: Mar. 1 to Dec. 15, weekdays 9–5, Sat. 10–5, Sun. 12–5.
Admission: fee charged, except on Mother's Day and during the Fall Harvest Show and Plant Benefit Sales.
Directions: U.S. 31, north of Niles, to Walton Rd.; Walton to Range Line Rd.; U.S. 12 to Buchanan Exit (Redbud Trail); turn right onto River St.; River to Range Line Rd.

Fernwood, an educational center, combines a botanic garden and arboretum, a nature center and an arts and crafts center. On the 105-acre site, over 3,000 kinds of native and exotic plants can be found in natural and landscaped areas.

Five acres of gardens and a greenhouse (1,300 sq. ft.) demonstrate home landscape ideas for the Michigan-Indiana area. In the Rock and Bog Garden, an extensive collection of dwarf conifers is combined with heaths, heathers, primroses, iris, ferns, saxifrages and bulbs. Assembled in the 40-acre arboretum are examples of all of Michigan's native trees, plus trees recommended for street and home use. Eighteen acres of Fernwood's grounds are devoted to nature study (over 100 species of ferns are presented), and five acres form a re-created tall-grass prairie.

Fernwood opened to the public in 1964 when Mrs. Mary L. Plym purchased 16 acres and provided an endowment for the development of an educational preserve.

Hidden Lake Gardens

Michigan State University **(517) 431-2060**
Tipton, MI 49287

Hours: grounds, Apr.–Oct., weekdays 8 to 30 min. before sundown; Nov.–Mar., weekdays 8–4:30; weekends and holidays 9–4:30; Garden Center Building, weekdays 8–noon, 12:30–4:30; weekends and holidays 12–6; closed during the winter; conservatory, same hours as the grounds; closes at 7, Apr.–Oct., and at 4:30, Nov.–Mar.
Admission: fee charged; no fee Nov.–Mar.

On 670 acres of knolls and valleys among Michigan's Irish Hills, the grounds and conservatories of Hidden Lake Gardens exhibit about 5,200 plant taxa. Seven miles of roadway and trails radiating from six-acre Hidden Lake allow visitors access to the plantings.

Collections include crabapples, flowering cherries, hawthorns, junipers, lilacs, magnolias, maples, mountain ashes, pines, rhododendrons, azaleas, shrub roses, spruces, dwarf and rare conifers, willows and yews. Featured sections are the Demonstration Garden, Ground Covers, Ornamental Evergreens, Exotic Evergreens, the Great Meadow, Lowland Hardwoods, Aristocrats and Oak Upland Forests. The conservatory complex (8,000 sq. ft.) consists of the Temperate House and two domed structures — the Tropical House and the Arid House.

Mr. Harry Fee, a prominent local businessman, started the Gardens in 1926; he gave them to Michigan State University in 1945.

Minnesota

Minnesota Landscape Arboretum and Horticultural Research Center

University of Minnesota **(612) 443-2460**
3675 Arboretum Dr.
P.O. Box 39
Chanhassen, MN 55317

A Collection of Gardens

Japanese Garden,
Goldsmith Civic Garden Center,
Memphis Tennessee

Fairchild
Tropical Garden,
Miami, Florida

Claire Sawyers

Magnolia Plaza and
Administration Building,
Brooklyn Botanic Garden,
Brooklyn, New York

Elvin McDonald

Missouri Botanical Garden,
St. Louis, Missouri

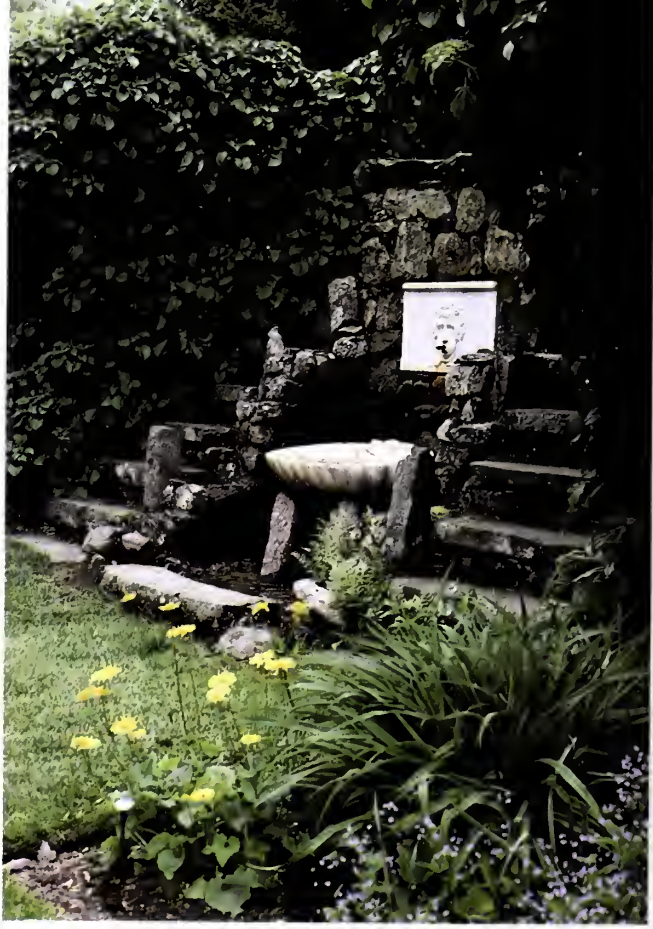
Dixon Gallery and Gardens,
Memphis, Tennessee

Elvin McDonald

Old Westbury Gardens, Westbury, Long Island, New York

San Francisco Park Conservatory, San Francisco, California

Claire Sawyers



Elvin McDonald

Blithewold Gardens and Arboretum, Bristol, Rhode Island

Longwood Gardens Conservatory, Kennett Square, Pennsylvania

Claire Sawyers

Hours: Closed major holidays; call ahead for specifics; otherwise, grounds: summer—every day, 8–dusk; winter—every day 8–5:30; buildings: weekdays—8–4:30; weekends—11–4:30
Admission: fee charged; no fee for members.
Directions: Minnesota St. Hwy. 5, 9 mi. west of I–94.

Rolling hills (with natural stands of maple, linden, ash, oak and hornbeam), open fields, two natural lakes, marshland and landscape gardens can all be found on the 550 acres of the Minnesota Landscape Arboretum open to the public (total acres number 975). Three miles of roads and more than six miles of walking trails facilitate exploration of the various areas. Extensive plant collections and demonstration gardens offer new ideas to homeowners, and research conducted at the site focuses on woody ornamentals and fruit trees and their adaptation to northern climates.

The Arboretum's original 160 acres were purchased by the Minnesota State Horticultural Society and donated to the University in 1958. The Arboretum Foundation was established in 1970, and the Arboretum and Horticultural Research Center were administratively combined in 1984.

Como Park Conservatory

Midway Pkwy. and Kaufman Dr.
St. Paul, MN 55103
(612) 489-1740

Hours: every day 10–6.
Admission: fee charged; no fee mid–Apr. to mid–Nov.
Directions: 2 mi. north I–94, just west of Lexington Ave.
Public Transportation: accessible by bus.

The Como Park Conservatory, covering about three acres, was planned in 1913 by the Board of Park Commissioners and completed in 1915.

Today, the display houses contain many of their original plantings. About 200 taxa are represented, with over 200 permanently planted specimens and seasonal floral displays. The Central Palm House (100 ft. in diameter, 65 ft. tall) shelters 26 species of palms. Economic plants, plants mentioned in the Bible, Flower Shows, Sunken Gardens, ferns and cacti are featured in other houses. Just outside the Conservatory are the McKnight Formal Gardens. The Japanese Garden is another of the Park's horticultural features.

Mississippi

The Crosby Arboretum

3702 Hardy St.
Hattiesburg, MS 39401
(601) 264-5249

Hours: by appointment.
Admission: no fee.
Directions: adjacent to the State Hospitality Center on I–59, Picayune, MS.

The Crosby Arboretum is a living tribute to L.O. Crosby, Jr., with a permanent collection and display of native trees and plants for purposes of education and research. L.O. Crosby, Jr. (1907–1978), whose father founded the Goodyear Yellow Pine Company, was involved in horticultural endeavors much of his life. His family established the Crosby Arboretum Foundation in 1979.

The 58-acre site displays over 300 species of trees, shrubs, wildflowers and grasses indigenous to south-central Mississippi and Louisiana. Natural ecosystems represented include pitcher plant bog, natural slash-pine savanna, bottomland hardwood forest and cypress swamp.

Missouri

Shaw Arboretum
(of the Missouri Botanical Garden)

P.O. Box 38
Gray Summit, MO 63039
(314) 577-5138

Shaw Arboretum of the Missouri Botanical Garden, Gray Summit, Missouri

Hours: grounds, every day 7 to ½ hr. past sunset; Visitor Center, spring and fall, weekdays 8–4, weekends 9–4.
Admission: fee charged.
Directions: about 35 mi. southwest of St. Louis and south of Gray Summit; entrance is near the intersection of I–44 and State Hwy. 100.
Public Transportation: accessible by Trailways, Greyhound and Mid-American buses (Diamond stop).

Nearly four sq. mi., or 2,400 acres, of natural Ozark landscape form the Shaw Arboretum. Bordered on one side by the Meramec River, 1,800 acres are open to the public. Managed plantings include the 50-acre Pinetum and 60-acre prairie. A 12-mi. trail system allows visitors to enjoy the wooded sections of the Arboretum.

Jewel Box

Forest Park
5600 Clayton
St. Louis, MO 63110
(314) 534-9433

Hours: every day 9–5.
Admission: fee charged, except Mon. and Tues. 9–noon.
Directions: west on Hwy. 40 to Forest Park Zoo exit; enter Park on Hampton Ave. and Hwy. 40; Hampton to Wells Dr.; left on Wells, then left on McKinley Dr.

This unique structure, located in the city's largest park, was erected in 1936, and its design reflects the architectural style of that period. Six seasonal floral displays are staged each year in the 144 ft.–long, 55 ft.–wide and 50 ft.–tall Main Display Room. Tropical trees, foliage plants, waterfalls and fountains may be seen year-round.

Missouri Botanical Garden

Location:
4344 Shaw Blvd.
St. Louis, MO 63110
(314) 577-5100
Mailing Address:
P.O. Box 299
St. Louis, MO 63166

Hours: every day 9–5; Memorial Day to Labor Day 9–8; closed Dec. 25.
Admission: fee charged.
Directions: south of I–44; take Kings Hwy. to Tower Grove Ave.; east on Tower Grove.
Public Transportation: accessible by bus.

The Missouri Botanical Garden, 79 acres of pools, fountains, specialty gardens and greenhouses, is the "oldest botanical garden in the U.S. . .established in 1859." It features over 5,000 kinds of plants and is listed as a National Historic Landmark.

The Climatron, a geodesic-dome conservatory covering one-half acre, is divided into four separate climatic environments. Orchids, bromeliads, carnivorous plants, tropical trees and other exotics are all displayed around a central waterfall. Other greenhouses include the Desert and Mediterranean Houses and Linnaean Greenhouse, which dates from 1881. The four glass structures cover 30,950 sq. ft.

Areas of interest outdoors include the Japanese Garden — surrounding a lake and featuring a teahouse, boulders, bridges and Japanese ornaments — two rose gardens, the Scented Garden, designed especially for the visually handicapped, and the English Woodland Garden. Tower Grove House, the former residence of Henry Shaw, founder of the Garden, is another attraction.

Shaw, an Englishman who made his fortune when St. Louis was still a pioneer town, started the Botanical Garden on the advice of prominent botanists Dr. Engelmann, Asa Gray and Sir Joseph Hooker, later director of the Royal Botanic Gardens at Kew. Shaw devoted the last 30 years of his life to this project. He died in 1899, leaving the Garden to be operated as a not-for-profit organization.

Nebraska

Nebraska Statewide Arboretum

111 Forestry Science Laboratory
University of Nebraska
Lincoln, NE 68508
(402) 472-2971

The Nebraska Statewide Arboretum is a unique concept uniting over 30 separate arboreta throughout Nebraska into a single administrative unit. The following, listed alphabetically, are all under the aegis of the statewide organization:

Alliance: Sallows Arboretum and Conservatory
Bellevue: Bellevue College Arboretum
Blair: Blair City Parks
Dana College
Cedar Rapids: Cedar Rapids Public Schools Arboretum
Chadron: Chadron State College
Columbus: Elks Country Club Arboretum
Crete: Crete Public Schools Arboretum
Doane College
Curtis: School of Technical Agriculture—Curtis Arboretum
Fremont: Luther Hormel Memorial Park
Halsey: Bessey Arboretum
Kearney: Cottonmill Park
Kearney State College
Lincoln: Alice Abel Arboretum
Chet Ager Nature Center
Earl Maxwell Arboretum, UNL East Campus
Hans Burchardt Arboretum
Joshua Turner Arboretum, Union College
Lincoln Regional Center Arboretum
Nebraska State Capitol Arboretum
Nebraska State Fairgrounds
Prairie Pines
Nebraska City: Arbor Lodge State Park (see descriptive entry)
North Platte: Glenn Viehmeyer Arboretum
Omaha: Elmwood Arboretum
Ord: Aagard Farm
Plattsmouth: Horning Farm
Scottsbluff: Panhandle Station Arboretum
Stanton: Maskenthine Lake and Recreation Area
Stromsburg: Midwest Park Arboretum
Wayne: Wayne State College

Arbor Lodge State Historical Park and Arboretum

Nebraska Game and Parks Commission
Nebraska City, NE 68410
(402) 873-3221

Hours: grounds, every day 8–dusk; mansion, Apr. 15 to May 29, every day 1–5; May 30 to Sept. 7, every day 9–5; Sept. 8 to Oct., every day 1–5.
Admission: grounds, no fee; mansion, fee charged.

Directions: located at the west edge of Nebraska City, about one mi. from State Hwy. 73-75 and 2; Arbor Lodge turn is marked on both State Hwys.

In 1923 Joy Morton donated his 52-room, neo-colonial mansion, Arbor Lodge, and surrounding gardens and grounds to the State of Nebraska to be preserved as a monument to his father, J. Sterling Morton. The elder Morton settled in Nebraska City in 1855. Despite Nebraska's treeless plains, by 1858 the Mortons had established orchards and ornamental trees and shrubs on the grounds of their estate.

Joy Morton, the founder of Morton Salt, inherited Arbor Lodge from his father in 1902. He enlarged the mansion and built the elaborate Carriage House and Italian Terrace Garden. Originally planted by the Morton family, the Arboretum covers 65 acres and features over 250 species of trees and shrubs (thirteen trees are state champions). The Prairie Plants Garden, a display of native ornamental grasses and wildflowers, was established in recent years.

New Hampshire

Saint-Gaudens National Historic Site

RR #2, P.O. Box 73 **(603) 675-2175**
Cornish, NH 03745

Hours: last weekend in May to Oct., every day; grounds, 8–dusk; buildings, 8:30–4:30.
Admission: fee charged.
Directions: I–89, exit 20; I–91, exit 8.

The former home and studios of the American sculptor Augustus Saint-Gaudens (1848-1907) is landscaped with terrace gardens, hedge-lined garden enclosures, expanses of lawn and stands of trees. Statues and fountains accent the gardens, and trails wind through naturalized woodlands and wetlands. The property was deeded to a board of trustees in 1907, and in 1964 it was accepted as a gift by the National Park Service.

Fuller Gardens

10 Willow Ave. **(603) 964-5414**
North Hampton, NH 03862

Hours: early May through Oct., every day 10–6.
Admission: fee charged.
Directions: I–95 to Rt. 1 exit; Rt. 1 to Rt. 101–D; follow 101–D east to junction with Rt. 1–A; go 200 yds. north on 1–A to Willow Ave.

Fuller Gardens, the summer home of the late Massachusetts Governor Alvan T. Fuller, preserves the horticultural beauty of an early 20th-century estate. Although the house no longer stands, the two-acre Gardens remain. These feature extensive plantings of roses set off by statuary and fountains, as well as a breathtaking ocean view. Additional highlights include the Japanese garden, wildflower walk, colorful perennial borders and annual beds enclosed by sculptured hedges and a conservatory filled with exotic tropical and desert plants.

The Gardens are maintained by the Fuller Foundation of New Hampshire.

Moffatt-Ladd House and Garden

154 Market St. **(603) 436-8221**
Portsmouth, NH 03801

Hours: June 15 to Oct. 15, Mon.–Sat. 10–4, Sun. 2–5.
Admission: fee charged.
Directions: I–95 to Portsmouth; exit 7 (Market St.).

Although the Moffatt-Ladd House was built in 1763, the present garden design reflects the era of A.H. Ladd, who acquired the property in 1862. The House and grounds, designated as a National Historic Landmark in 1970, are maintained by the National Society of the Colonial Dames of America. The 2½-acre garden features brick walks, rose arbors, an herb garden, raised flower beds, grass steps, a grape arbor and old beehives. Old-fashioned peren-

nials add to the historic atmosphere.

New Jersey

Leonard J. Buck Garden

Somerset County Park Commission
R.D. 2, Layton Rd.
Far Hills, NJ 07931
(201) 234-2677

Hours: Mon.–Sat. 10–4; Sun. noon–4 (winter) and noon–6 (summer)
Admission: no fee.
Directions: from I–287, take the Bedminster exit onto Rt. 202; through Bedminster and Far Hills; turn righ. at Liberty Corner Rd.; continue 1 mi., turn right at Layton Rd.

The Leonard J. Buck Garden is a series of alpine and woodland gardens situated in a 33-acre stream valley. It was originally developed in the late 1930s by Leonard Buck as part of his estate. The plantings include an extensive collection of azaleas and rhododendrons, wildflowers, a fern collection, exotic alpines and rockery plants.

The Garden was donated by Mr. Buck's widow, Helen Buck, to the Somerset County Park Commission in 1976.

The Frelinghuysen Arboretum

53 East Hanover Ave.
P.O. Box 1295R
Morristown, NJ 07960
(201) 829-0474

Hours: weekdays, 9–4:30; weekends, March to May 30, 9–5, June to Labor Day, 10–6, Labor Day to Thanksgiving Day, 9–5.
Admission: no fee.
Directions: north on I–287 to exit 32A; Morris Ave. east to Whippany Rd.; left onto East Hanover Ave.; entrance on left opposite Morris County Library. South on I–287 to exit 32 to Ridgedale Ave.; right onto Ridgedale, then right onto East Hanover Ave.; entrance on right.

The Frelinghuysen Arboretum consists of 127 acres divided into two tracts. The North Tract, made up of rich alluvial soil along the banks of the Whippany River, is under development as a demonstration area for public education. The South Tract is a varied, undulating terrain of swamp, forest and fields. Before becoming an Arboretum in 1971, the property was owned by the George Griswold Frelinghuysen family. Their former summer house, built in 1891, now serves as the Park Headquarters Administration Building for the Morris County Park Commission.

The demonstration area includes collections of lilacs, rhododendrons, azaleas, cherries, maples, hollies, conifers and viburnums. Other areas of interest are the Glossary Garden, Annual All-America Flower Garden, Rose Garden and Braille Nature Trail.

Reeves-Reed Arboretum, Summit, New Jersey (photo: Anne Ross)

Willowwood Arboretum

P.O. Box 129R
Morristown, NJ 07960
(201) 829-0474

Hours: every day 9–4:30; closed Dec. through Feb.
Admission: no fee.
Directions: I–287 north to exit 18B; Rt. 206 north for 4 mi. to Pottersville Rd. (Rt. 512);

left on Pottersville, right on Union Grove Rd., left on Longview Rd.; entrance is on the left.

Willowwood Arboretum, on 130 acres of rolling farmland, contains about 3,500 kinds of native and exotic plants. Many of these date from the original plantings of brothers Henry and Robert Tubbs who bought the property in 1908. Two small formal gardens flank a residential structure that dates from 1792. But the pervading feeling of the site, which has been carefully developed over the years, is one of informal paths through open areas and woodland. Collections emphasized include oaks, maples, willows, lilacs, magnolias, hollies, cherries and conifers.

Willowwood was established as a private Arboretum in 1950 and became a unit of the Morris County Park System in 1980.

Rutgers University
Research and Display Gardens

P.O. Box 231 **(201) 932-9325**
Cook College
New Brunswick, NJ 08903

Hours: every day 7–dusk; closed Dec. 10 to Jan. 2.
Admission: no fee.
Directions: at junction of Ryder La. and U.S. Rt. 1; 1 mi. north of junction of Rt. 1 and 130 and 1 mi. south of junction of Rt. 1 and 18.

About 1,200 kinds of plants can be seen on the 30 acres of the Research and Display Gardens of Rutgers University open to the public. Special collections include hollies, yews, rhododendrons and other ericaceous plants. Demonstration hedges and vines and an Annual Garden present ideas for homeowners.

Now state supported, the Gardens were established in 1935 by Dr. Charles Connors.

Skylands

Ringwood State Park **(201) 962-7031**
P.O. Box 302
Ringwood, NJ 07456

Hours: every day dawn–dusk.
Admission: fee charged.
Directions: New York State Thruway (I–87) to Rt. 17 north (at the I–87/287 interchange) to Sterling Mine Rd.; left at Shepard Lake Rd.
Public Transportation: Warwick Bus Line.

Skylands, dating from 1880, was once a private estate, with its gardens developed from 1920 to 1954 by Clarence McKenzie Lewis. Today, it is the only botanic garden in the New Jersey park system. Extending south from the manor house are Magnolia Walk and Octagonal, Azalea, Summer, Peony and Lilac Gardens. Other areas include the Pinetum, greenhouse and nursery, Dry Meadow, Swan Pond Meadow and Annual, Perennial, Bog, Rhododendron Display, Heather and Wildflower Gardens.

Duke Gardens Foundation, Inc.

P.O. Box 2030 **(201) 722-3700**
Hwy. 206 South
Somerville, NJ 08876

Hours: Oct. 1 to June 1, every day 12–4; advance reservation required; closed major holidays.
Admission: fee charged; school groups free Mon. and Fri.
Directions: located on Rt. 206, 17 mi. north of Princeton, 1½ mi. south of Somerville.

Duke Gardens is a unique collection of eleven greenhouses, each a full-scale re-creation of a garden of a particular style, country or period. These include: Chinese, Japanese, English, French, Italian, Indo-Persian, Colonial, Edwardian, American Desert and Tropical Jungle.

The Gardens were founded in 1960 when Doris Duke donated eleven acres of her estate,

with existing greenhouses, to the Foundation. They opened as a public attraction in 1964.

The Reeves-Reed Arboretum

165 Hobart Ave. **(201) 273-8787**
Summit, NJ 07901

Hours: every day 10–sunset.
Admission: no fee.
Directions: from Rt. 24 west take Hobart Ave. exit, turn left; entrance is second left off Hobart Ave. From Rt. 24 east, take Rt. 124 (service road) to Hobart Ave., turn right; entrance is second driveway on left.
Public Transportation: accessible by railroad and bus.

New York

Clark Garden

193 I. U. Willets Rd. **(516) 621-7568**
Albertson, NY 11507

Hours: weekdays 8–4:30; Sat., Sun. and holidays 10–4:30; Garden Shop, Tues.–Thurs. and weekends 11–3.
Admission: fee charged.
Directions: L.I. Expressway to exit 37 south; Willis Ave. south one mi. to I.U. Willets Rd.; left on Willets; half a mi. to Garden entrance on left.
Public Transportation: accessible by bus and Long Island Railroad.

Clark Garden, a suburban branch of Brooklyn Botanic Garden, displays on its 12 wooded acres trees, shrubs and garden plants that are commercially available and best suited to local climate conditions. Emphasis is on uncommon plants, small flowering trees and early- and late-flowering shrubs.

The New York Botanical Garden

Bronx, NY 10458 **(212) 220-8700**

Hours: grounds, every day dawn–dusk; Conservatory, every day 10–4; closed Dec. 25, Jan. 1 and Thanksgiving Day.
Admission: fee charged for Conservatory and parking.
Directions: located in north-central Bronx; Bronx River Pkwy. passes the eastern boundary of the Garden; vehicle entrance is on Southern (Kazimiroff) Blvd., across from the entrance to Fordham University and near the Bronx Zoo.
Public Transportation: accessible by subway, bus and New York City Metro North Railroad.

The New York Botanical Garden (NYBG), a 250-acre oasis amid the urban hubbub of the Bronx, is an institution dedicated to plant-

Pond in the Arboretum at Cornell Plantations, Ithaca, New York (photo: Jon Crispin)

science research. The star of the horticultural attractions is the Enid A. Haupt Conservatory. Originally completed in 1901, the structure was entirely restored during 1976–78. The eleven houses form a rectangular complex covering 44,000 sq. ft. and hosting seasonal displays and a variety of plant collections. The latter comprise Tropical, Subtropical, Old World Desert, American Desert and Fern Forest, complete with waterfall and pool. The Palm Grove, the central domed house, is 90 ft. high and 100 ft. in diameter.

Highlights of the extensive grounds include: a Rose Garden (200 varieties); Rock Garden, with a re-created alpine scene; Pinetum; Herb Garden; and Native Plant Garden, with New Jersey pine-barrens area and spring-fed marsh. The NYBG Forest is a 40-acre preserve representing the only uncut woodland in New York City. The Museum Building houses the herbarium and 100,000-volume library.

Helping found the Garden in 1891, Nathaniel Lord Britton envisioned it as the American equivalent of the Royal Botanic Gardens at Kew. The Garden was given land in 1895, and ground was broken for the Conservatory in 1899.

New York Zoological Society—Bronx Zoo

Bronx River Pkwy.	**(212) 367-1010**
at Fordham Rd.	**220-5141**
Bronx, NY 10460	**(tour reservations)**

Hours: summer, Mon.–Sat. 10–5, Sun. and holidays 10–5:30; winter, every day 10–4:30.
Admission: fee charged; no fee Tues.–Thurs.
Directions: Bronx River Pkwy. to Bronx Zoo exit; follow signs.

Just opposite the New York Botanical Garden lies the Bronx Zoo—the largest urban installation of its kind in America—with 265 acres of woods, ponds, streams and parkland where 4,000 animals are in residence. Exhibits feature natural-habitat settings that include indigenous plantings.

The 38-acre "wilderness" of Wild Asia offers tigers, rhinoceros, antelope, exotic deer and elephants. The World of Birds building contains a tropical rain forest. Lions and antelope inhabit African Plains, and in Wild Asia's Jungle World, gibbons, monkeys and water monitors live in a setting that is the "most

Enid A. Haupt Conservatory, The New York Botanical Garden, Bronx, New York (photo: Alexandra Timchula)

ambitious indoor animal display ever attempted."

The New York Zoological Society opened the zoo in 1899.

Wave Hill

675 W. 252nd St. **(212) 549-2055**
Bronx, NY 10471

Hours: every day 10–4:30.
Admission: no fee weekdays; fee charged weekends.
Directions: northbound on Henry Hudson Pkwy., exit at 246th St.; at 252nd St., turn left over the Pkwy. and left again; right at 249th St., straight to Wave Hill gate. Southbound on Henry Hudson Pkwy., exit at 254th St.; left at stop sign, left again at light; south to 249th St.; turn right, then straight ahead to gate.
Public Transportation: accessible by subway and bus.

Wave Hill, a Hudson River estate preserved for the public, sits on 28 acres, with the Hudson and the New Jersey Palisades forming a scenic backdrop. A turn-of-the-century atmosphere envelopes the houses and gardens of the property.

In 1893, when George Perkins, a wealthy financier, acquired the estate—including Wave Hill House, built in 1843—the gardens were laid out and surrounding properties (the nearby manor house Glyndor among them) were added.

Today, Wave Hill House shelters a series of changing exhibits. The 2,000 sq. ft. Conservatory encompasses seasonal floral displays and collections of cacti and succulents and tropicals. Other points of interest, both indoors and out, include the Flower Garden, Herb Garden, English-style Wild Garden, Aquatic Garden, Thematic Plant Exhibit and Alpine House. Below the formal-garden area, is a ten-acre stretch of woodland.

The site remained in private use until 1960 when it was given to the City. For the management of the property, Wave Hill, Inc. was formed in 1965.

Brooklyn Botanic Garden

1000 Washington Ave. **(718) 622-4433**
Brooklyn, NY 11225

Hours: grounds, May–Sept. weekdays 8–6, weekends and holidays 10–6; Oct.–Apr., weekdays 8–4:30, weekends and holidays 10–4:30; Japanese Garden hours change according to the season; Garden Shop, Apr.–Sept., weekdays 9:30–5:30, weekends and holidays 10–5:30; Oct.–Mar., weekdays 9:30–4:30, weekends and holidays 10–4:30; closed Thanksgiving Day, Dec. 25 and Jan. 1; grounds and Shop closed Mon.
Admission: grounds, no fee (donations accepted); Japanese Garden, fee charged weekends and holidays.
Directions: in Brooklyn, next to Prospect Park and Brooklyn Museum; from the north, Triborough Bridge to Brooklyn-Queens Expwy. (278); exit at Atlantic Ave., right at Washington Ave.; from the south, Staten Island Expwy. (278), across Verrazano Narrows Bridge, to Prospect Expwy.; exit at Fort Hamilton Pkwy., left at Caton Ave., left at Ocean Ave., left at Washington Ave.
Public Transportation: accessible by subway.

Between Prospect Park and the Brooklyn Museum, 52 acres, displaying over 12,000 kinds of plants, comprise Brooklyn Botanic Garden (BBG). Escape from bustling city streets is offered by a variety of specialized gardens. The Japanese Hill-and-Pond Garden is particularly tranquil. Built in 1914, it contains several Japanese-style structures and ornaments. The formal Cranford Rose Garden's more than 5,000 plants of 900 cultivars may be viewed in its entirety from atop the Overlook. From the same high vantage point, Cherry Esplanade may be admired. In full bloom each spring, this allée of Japanese cherry trees draws crowds of visitors to the Garden.

The Japanese Hill-and-Pond Garden, Brooklyn Botanic Garden, Brooklyn, New York (photo: George Malave)

Other areas of interest include: the Rock Garden; Fragrance Garden for the Blind; Magnolia Plaza; Shakespeare Garden; Herb Garden; Rhododendron Garden; Osborne Memorial Section; Local Flora Section, containing only those plants native to the area within a 100-mile radius of New York City; and the Children's Garden, representing the vegetable- and flower-growing efforts of over 300 young people each summer.

BBG was established in 1910 by a group of citizens interested in developing a public garden. Land for the project was leased by the City. Today, the Garden is overseen by Brooklyn Botanic Garden, Inc., a private organization. The Administration Building, designed in Italian-Renaissance style by McKim, Mead & White, has been designated a Historic Landmark. A new $21-million conservatory complex is scheduled to open in 1988.

Sonnenberg Gardens

P.O. Box 663 **(716) 394-4922**
Canandaigua, NY 14424

Hours: May 10 to mid–Oct., every day 9:30–5:30.
Admission: fee charged.
Directions: near New York State Thruway exits 43 and 44; located at 151 Charlotte off Rt. 21 north (E. Gibson St.); 1 mi. east of Main St. in Canandaigua.

George Landis Arboretum

Esperance, NY 12066 **(518) 875-6935**

Hours: Apr.–Nov., every day sunrise–sunset.
Admission: no fee.
Directions: located 30 mi. west of Albany, on Rt. 20, two mi. north of Esperance.

Over 2,000 kinds of herbaceous and woody plants may be seen at the George Landis Arboretum. The 96-acre site features a rose garden, rock garden, wildflower area, conifers, lilacs, rhododendrons and flowering crabapples. The Arboretum was founded in 1951 by Fred Lape.

Queens Botanical Garden

43-50 Main St. **(718) 886-3800**
Flushing, NY 11355

Hours: every day 8–sundown.
Admission: no fee (contributions accepted).
Directions: College Point exit off Van Wyck Expwy.; Main St. exit off Long Island Expwy. (past Booth Memorial Hospital).
Public Transportation: accessible by IRT subway (#7); Main St. stop.

The Queens Botanical Garden, situated on 39 acres in a densely populated metropolitan area, strives to serve homeowners and plant lovers in the surrounding community. Formal landscaped areas include: the rose collection, featuring over 5,000 plants; six backyard demonstration gardens, offering ideas for a small urban plot; the Rock Garden; and the Herb Garden. Collections of crabapples, cherries, maples, magnolias and historic trees and shrubs of Flushing dot the parklike arboretum section of the Garden.

The Queens Botanical Garden Society was established in 1946. In 1960 the Garden was moved from its original location to make room for the 1964–65 World's Fair. It opened at its present site in 1963.

Cornell Plantations

1 Plantations Rd. **(607) 256-3020**
Ithaca, NY 14850

Hours: grounds, every day sunrise–sunset; headquarters building, weekdays 8–4, weekends 12–4.
Admission: no fee.
Directions: off Rt. 366 in Ithaca.
Public Transportation: accessible by bus.

Cornell Plantations, combining features of an arboretum, botanical garden and natural preserve, is made up of 2,800 acres of steep gorges, ponds, streams, woodland, hilly terrain, swamp areas and specialized gardens. Eleven off-campus natural areas contribute to the Plantations' total acreage.

Specialized areas include: Robison York State Herb Garden; Heasley Rock Garden; American Peony Society Garden; International Crops and Weed Garden; Rhododendron, Ground cover, Rose and Heritage Crops Collections; and Lath House.

The Plantations began in 1935 when University administrators and professors saw the need for an outdoor laboratory for students and the general public.

Bailey Arboretum

Bayville Rd. **(516) 676-4497**
Locust Valley, NY 11560

Hours: mid–April to mid–Nov., every day 9–4; closed Mon.
Admission: fee charged.
Directions: from intersection of Rt. 25A and Wolver Hollow Rd. (Brookville Police Station), follow signs for Arboretum.

Formerly the summer home of Mr. and Mrs. Frank Bailey, the 42 acres and house (built in the 1800s) that make up Bailey Arboretum were given to Nassau County in 1968 and are maintained by the Department of Recreation and Parks. Outstanding features are an iris garden, rose garden, perennial border, rock garden and a collection of over 600 kinds of trees and shrubs, including many rare species.

The John P. Humes Japanese Stroll Garden

347 Oyster Bay Rd. **(516) 676-4486**
Locust Valley, NY 11560

Admission: fee charged.
Directions: Long Island Expwy. exit 39N to Rt. 25A (Northern Blvd.); turn right and go 3 mi. to Wolver Hollow Rd., turn left to end, turn right on Chicken Valley Rd.; proceed 1.8 mi. to Dogwood La., turn right. Entrance is 200 ft. on right.

Public Transportation: Long Island Railroad to Locust Valley, then taxi (2 mi.).

Innisfree Garden

Tyrrel Rd. **(914) 677-8000**
Millbrook, NY 12545

Hours: May–Oct., weekends 11–5, Wed.–Fri. 10–4; closed Mon. and Tues.; open Mon. legal holidays.
Admission: weekends, fee charged; weekdays, no fee.
Directions: on Tyrrel Rd. 1 mi. from Rt. 44; 2½ mi. from South Millbrook on Rt. 44, turn left on Tyrrel Rd.; 1¾ mi. from Taconic Pkwy. overpass on Rt. 44, turn right on Tyrrel Rd.

Innisfree Garden comprises a 180-acre basin of "naturalized" gardens and woodland surrounding a picturesque lake. Walter Beck, the Garden's creator, was a student of Oriental art. Beginning in 1930 and using eastern design principles, he worked for 22 years staking out streams, walkways and plantings. The terraces, retaining walls, sculptural groupings of natural rock, waterfalls and planned vistas of the lake were organized to keep elements "in tension," or "in motion."

The Garden was given to the Innisfree Foundation in 1959.

Mary Flagler Cary Arboretum
Institute of Ecosystem Studies

Box AB **(914) 677-5358**
Millbrook, NY 12545

Hours: Mon.–Sat. 9–4, Sun. 1–4; closed holidays.
Admission: no fee; obtain a Visitor Access Permit at the Gifford House Visitor and Education Center.
Directions: located 75 mi. north of New York City; Taconic Pkwy. to Rt. 44 east; two mi. to 44A; after one mi., Gifford House is the second building on the left.

The Mary Flagler Cary Arboretum property was acquired in 1971 by The New York Botanical Garden. It is now the site of the Institute of Ecosystem Studies. Formerly the estate of Mrs. Mary Flagler Cary, the Arboretum was established in her memory by a trust.

Features include: five miles of paved road and two nature trails; the Gifford House (built in 1817), containing a small reference library and Gift and Plant Shop; the Perennial Garden, offering examples of low-maintenance choices; 60 cultivars of lilacs; the Greenhouse, where visitors may see tropical plants and propagation techniques; and the Fern Glen, displaying an extensive collection of hardy ferns from Europe, Japan, the Soviet Union, Mexico and parts of North America.

The Astor Court, The Metropolitan Museum of Art, New York. (The installation made possible through the generosity of the Vincent Astor Foundation.)

Sonnenberg Gardens, Canadaigua, New York

Mohonk Mountain House

New Paltz, NY 12561 **(914) 255-1000**

Admission: fee charged; no fee for House guests.
Directions: six mi. west of New Paltz; New York State Thruway to exit 18; left at Rt. 299; after crossing the Wallkill River, turn right, bear left at the next "Y" and follow Mountain Rest Rd.
Public Transportation: shuttle bus from bus station in New Paltz.

Mohonk Mountain House is a Victorian-inspired resort made up of 25,000 acres of unspoiled countryside and a crystal-clear lake. Surrounding the House, 15 acres of gardens feature extensive annual and perennial borders, a rock garden, wildflower-fern trail, rose garden, herb garden, greenhouses and specimen trees and shrubs. A five-day Garden Holiday program, with lectures and demonstrations, is scheduled each year. The House opened to guests in 1870 and, today, can accommodate as many as 500.

The Astor Court

Department of Far Eastern Art
Metropolitan Museum of Art
5th Ave. at 82nd St.
New York, NY 10028 **(212) 879-5500**

Hours: Wed.–Sun. 9:30–5:15; Tues. 9:30–8:45; closed Mon.
Admission: contribution suggested.
Directions: 5th Ave. at 82nd St.; parking available in Museum garage at 80th St.
Public Transportation: accessible by Lexington Ave. subway; use 86th (express) or 78th St. (local) stops; bus routes 1, 2, 3, 4, 17 or 18.

The Biblical Garden at the Cathedral of St. John the Divine

1047 Amsterdam Ave. **(212) 678-6886**
New York, NY 10025 **864-3760**

Hours: every day 9–sunset.
Admission: no fee.
Directions: Westside Hwy. to 96th St. exit, north to 110th St.; east on 110th St. to Amsterdam Ave., north again to 112th St.
Public Transportation: accessible by New York City bus and subway.

The Biblical Garden at the Cathedral of St. John the Divine, New York City

The Cloisters

The Metropolitan Museum of Art
Fort Tryon Park
New York, NY 10040
(212) 923-3700

Hours: Mar.–Oct., Tues.–Sun. 9:30–5:15; Nov.–Feb., Tues.–Sun. 9:30–4:45; closed Mon., Thanksgiving Day, Dec. 25 and Jan 1.

Admission: donation requested.
Directions: from Manhattan, Henry Hudson Pkwy. north to the first exit after the George Washington Bridge.
Public Transportation: accessible by Madison Ave. bus #4; also, 8th Ave. subway "A" train to 190th St., then bus #4 to the Cloisters.

The Cloisters, a branch of The Metropolitan Museum of Art, presents examples of medieval art, architecture and cloister gardens. On a bluff overlooking the Hudson River, a single structure incorporates sections of a 12th-century chapter house, the cloisters of five medieval monasteries and a Romanesque chapel. The gardens are planted with materials grown in western Europe during the Middle Ages (800–1520 A.D.).

On the ground floor are the Bonnefont and Trie Cloisters. The former's two arcades of white marble capitals enclose a medieval herb garden. The Trie Cloister garden features plants that are depicted in the famous *Hunt of the Unicorn* tapestries, in the collection of the Museum. An indoor spring garden surrounds a fountain in the Saint-Guilhem Cloister. Fragrant plants are grown in the courtyard garden of the Cuxa Cloister.

The building and the art collection it houses were funded by John D. Rockefeller, Jr. The Cloisters opened to the public in 1938.

The Conservatory Garden, Central Park

830 Fifth Ave. **(212) 360-8236**
New York, NY 10021

Hours: 8–dusk.
Admission: no fee.
Directions: located at 105th St. and Fifth Ave., on the edge of Central Park.
Public Transportation: accessible by Fifth Ave. bus; Lexington Ave. subway to 103rd St.

The Conservatory Garden features six acres of formal plantings, with hundreds of roses, a wisteria pergola, crabapple allées, bulbs, perennial borders and three water installations. Built on the former site of a series of conservatories, the Garden opened 1937 and was recently restored by the Central Park Conservancy.

Bayard Cutting Arboretum

P.O. Box 466 **(516) 581-1002**
Montauk Hwy.
Oakdale, NY 11709

Hours: Wed.–Sun. 10–5; open legal holidays.
Admission: fee charged, except during winter months.
Directions: Southern State Pkwy. (Heckscher Pkwy.), exit 45 east to Montauk Hwy.; entrance is on Montauk Hwy., one mi. east of Pkwy.
Public Transportation: accessible by Long Island Railroad to Islip Station, then taxi (3 mi.) to the Arboretum; MSBA bus rt. S40 serves Montauk Hwy.

Bayard Cutting Arboretum sits on a 690-acre strip of land along the Connetquot River. It was developed in the late 1800s as the private residence of Mr. and Mrs. Bayard Cutting. In 1952 Mrs. Cutting gave the estate to the Long Island State Park and Recreation Commission. About 1,200 kinds of plants may be seen on the 130 acres open to the public.

The Arboretum's naturalistic design was laid out by Frederick Law Olmsted in 1887 and is listed in the Register of Historic Landmarks. Although the site suffered severe hurricane damage in 1985, many specimens that date back to the original plantings survive in the Pinetum. These include fir, spruce, pine, cypress, cedar, yew and hemlock trees. Among the numerous pathways available, five recommended routes are outlined for visitors: Pinetum Walk, Wildflower Walk, Rhododendron Walk, Bird Watcher's Walk and Swamp Cypress Walk.

Old Westbury Gardens

P.O. Box 430
Old Westbury, NY 11568

Hours: May–Oct., Wed.–Sun. and all holidays 10–5; April and Nov., Sun. 11–4.
Admission: separate fees for house and Gardens.

Directions: Long Island Expwy. to exit 39S; 1¼ mi. east on service rd.; ¼ mi. south on Old Westbury Rd.

Public Transportation: Long Island Railroad to Westbury Station; taxi (2 mi.) from there.

Old Westbury Gardens maintains the same 18th-century English country estate atmosphere it evoked as the private residence of the late John S. Phipps. Built in 1906, the Charles II-style manor house and display garden are the creation of George Crawley, a London designer and collector. Listed in the National Register of Historic Places, the 70-acre estate is preserved as an example of the grandeur of the early 20th century.

Distinct garden areas lie on both sides of the formal, hedge-lined axis behind the mansion. Boxwood, already 100 years old when it was planted 50 years ago, borders the reflecting pool in the Boxwood Garden. Lilac Walk leads to the Walled Garden, famous for its extensive herbaceous borders; 1½ acres of floral displays complement ornamental pools, fountains and arbors in this enclosed area. The Pinetum and sunken Rose Garden are nearby. In addition, contemporary demonstration gardens provide visitors with practical ideas for their own gardens. Woodland Walk loops around the lake to the Temple of Love and back to the manor house. Inside the stately residence, rooms filled with art objects and English antiques remain as they were over 75 years ago.

In 1959 the Phipps family established a foundation to preserve the estate.

Planting Fields Arboretum

Planting Fields Rd. **(516) 922-9201**
Oyster Bay, NY 11771

Hours: grounds, every day 10–5; greenhouses, every day 10–4:30; closed Dec. 25.
Admission: fee charged weekends and holidays year-round and every day May 1 to Labor Day.
Directions: Long Island Expwy. to exit 41 north; Rt. 106 (Jericho-Oyster Bay Rd.) to Rt. 25A; left (west) on 25A; right on Mill River Rd.; north to Glen Cove Rd.; left on Planting Fields Rd.; entrance is on the left.

Once the private estate of William Coe, Planting Fields Arboretum is 400 acres of formal and informal gardens containing about 6,500 kinds of plants.

Coe Hall, the manor house on the property, is a fine example of Elizabethan architecture. To the north, 40 acres of lawn and large specimen trees immediately set off the mansion. To the south are the camellia greenhouse (over 100 varieties) and the main greenhouse complex, featuring six changing floral displays each year. Rhododendron Park encompasses an extensive collection of more than 800 species and hybrids. The five-acre Synoptic Garden, an alphabetically arranged collection of shrubs, contains over 400 superior species and cultivars. The Dwarf Conifer Garden, Formal Gardens, Wildflower Garden and Bird Sanctuary are other areas of interest.

William Coe died in 1955, after bequeathing the horticultural showplace he had developed over his lifetime to the people of New York State. Today, the Arboretum is registered as a Historic District and is administered by the Long Island State Park Commission.

Highland Park

Monroe County Parks **(716) 244-464**
Arboretum
375 Westfall Rd.
Rochester, NY 14620

New York Zoological Society-Bronx Zoo, Bronx, New York (photo: New York Zoological Society photo)

Hours: every day dawn to dusk; conservatory, every day 9:30–5.
Admission: no fee.
Directions: 1 mi. south of Goodman St. exit off I–490; south of downtown Rochester; bordered by South Ave., Highland Ave. and Goodman St.
Public Transportation: accessible by bus.

Highland Park is most famous for its Festival of Lilacs, but the 155-acre park has about 2,500 different kinds of plants.

The park is an arboretum of mature plantings including rhododendrons, azaleas, viburnums, forsythias, magnolias, mock-oranges, and cherries. The Pinetum contins mature and unusual pines, firs, and other evergreens, some of which have passsed their 100th birthday. The lilacs, the highlight in May, are a display of over 1,200 shrubs of 500 varieties covering 22 acres. Tulip beds (15,000 bulbs) and a pansy bed (10,000 plants arranged in a design) add to the May festivities. (The festival starts the third Sunday in May, runs for 10 days).

Lamberton Conservatory (5,400 sq. feet), within the park, dates back to 1911. It houses seasonal exhibits, tropical foliage plants, orchids and cacti and succulents.

Highland Park started in 1888 when Ellwanger and Barry Nursery donated 20 acres to the community which soon became famed as one of the nation's first great municipal arboreta. The lilac collection was established in 1892 when John Dunbar gave 20 varieties.

North Carolina

Biltmore House and Gardens

Asheville, NC 28802 **(704) 274-1776**
For further info. contact:
The Biltmore Co. Marketing Dept.
1 Biltmore Plaza
Asheville, NC 28802

Hours: every day 9–5; closed Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: fee charged for various tours.

Directions: located on U.S. 23, 3 blocks north of exit 50 or 50B on I–40 in Asheville.

Biltmore House, the former home of George Vanderbilt (grandson of "Commodore" Vanderbilt) is modeled after the great chateaux of France. The formal gardens are based specifically on those of Vaux-le-Vicomte. The 250-acre parklike landscape surrounding the mansion is probably one of the best-preserved designs of Frederick Law Olmsted.

The outstanding horticultural features of this National Historic Landmark include: the Victorian Conservatory, a three-wing structure covering over 7,000 sq. ft.; the four-acre, English-style Walled Garden; the Azalea Garden, an extensive collection of native, deciduous varieties; the 3,000-plant Rose Garden; the Italian Garden, with three pools containing aquatic plants; and the Shrub Garden, where paths wind among flowering trees and shrubs. Potted plants decorate many of the mansion's 250 lavishly appointed rooms, but they reign supreme in Palm Court, a sunken conservatory within the house.

After George Vanderbilt's death in 1914, a large portion of the estate's 125,000 acres was deeded to the government to form Pisgah

Biltmore House and Gardens, Asheville, North Carolina

National Forest. In 1930 Mr. Vanderbilt's only child Cornelia, together with her husband, opened the House and Gardens to the public. Today, the estate comprises 8,000 acres.

University Botanical Gardens at Asheville, Inc.

University of North Carolina—Asheville
W.T. Weaver Blvd.
Asheville, NC 28804
(704) 252-5190
(Visitor Center)

Hours: every day dawn–dusk.
Admission: no fee.
Directions: I–240 to Expwy. (U.S. 19, 23, 70) north; exit at Broadway (south); left on W.T. Weaver Blvd.

Ten acres devoted to the preservation and display of flora native to North Carolina make up the University Botanical Gardens at Asheville. The land is owned by the University, but has been entrusted to the University Botanical Gardens Association for development.

Displaying 750 kinds of plants from all parts of North Carolina, the Gardens include the Sunshine Garden, Bog Garden, Azalea Garden, Founder's Award Rock Garden, Garden for the Blind, Heath Cove and Sycamore Area, with trails, three streams and natural rock outcroppings. The institution also acts as a testing ground for new plants considered for introduction into the area.

The University Botanical Gardens were founded in 1960 with the help of the Asheville Garden Club.

The North Carolina Botanical Garden

UNC-CH Totten Center
457-A Chapel Hill,
NC 27514
(919) 967-2246

Hours: Mon.–Fri. 8–5, except winter holidays; mid–Mar. to mid–Nov., Sat. 10–5, Sun. 2–5.
Admission: no fee.
Directions: on Laurel Hill Rd., just south of U.S. 15–501 and 54 bypass in Chapel Hill.

The North Carolina Botanical Garden's main visitor area features collections of native southeastern plants (arranged according to habit) and more than two mi. of trails through Piedmont woodland. Highlights include displays of wildflowers, ferns, carnivorous and aquatic plants, plus an herb garden and plant-families garden. The NCBG is committed to the conservation of native plants through natural-area preservation and propagation.

Included in the 525-acre installation are the five-acre Coker Arboretum and 352-acre Mason Biological Farm. The Arboretum, on campus, has significant plantings of dwarf conifers, daffodils, Asian species, rhododendron and azalea cultivars and daylilies. It was originally designed in 1903, and today displays 1,000 kinds of plants.

The Van Landingham Glen and Susie Harwood Garden

Biology Department
University of North Carolina at Charlotte
Charlotte, NC 28223
(704) 597-4055

Hours: every day 8–dark.
Admission: no fee.
Directions: 9 mi. northeast of the center of Charlotte, on Rt. 49; on the UNCC campus.
Public Transportation: accessible by city bus from downtown Charlotte.

Sarah P. Duke Gardens

Duke University
Durham, NC 22706
(919) 684-3698

Hours: every day 8–dark.
Admission: no fee.
Directions: adjacent to Duke University and Medical Center; main entrance is on Anderson St.

About 1,500 kinds of plants adorn the 15 acres of formal and informal gardens that comprise Duke University's Sarah P. Duke Gardens. The formal Terraced Garden, sloping down to a pond, is the focal centerpiece. Stone-terraced beds, stretching out on either side of a broad stairway, are softened with flowering and evergreen trees, mixed with showy bulbs and annuals through spring and summer. The contrasting Blomquist Garden, set in a natural woodland, is limited to native plants. The Rose Garden, Azalea Court, Wisteria Pergola, Rock Garden, Asian Plant Collection and Iris Garden are other features.

The Gardens originated in 1932, when Dr. Hanes of Duke University Hospital gained financial support for their development from Sarah Duke. The installation opened to the public in 1934.

Tryon Palace Restoration and Garden Complex

P.O. Box 1007 **(919) 638-5109**
610 Pollock St.
New Bern, NC 28560

Hours: Mon.–Sat. 9:30–5, Sun. 1:30–5; closed Thanksgiving Day, Dec. 24–26 and Jan. 1.
Admission: fee charged.
Directions: 90 mi. east of I–95 on U.S. 70; U. S. 17 also passes through New Bern; in Historic New Bern, at the intersection of Pollock and George Sts.

North Carolina State University Arboretum

Department of Horticultural Science **(919) 737-3132**

University Botanical Gardens at Asheville, Inc., North Carolina (photo: Dr. Robert T. Kemp)

North Carolina State University
Raleigh, NC 27695

Hours: every day dawn–dusk.
Admission: no fee.
Directions: near the State Fairgrounds; take Hillsborough St. exit off I–64 Bypass; west on Hillsborough; take first crossing (left) over railroad tracks, then left at Beryl Rd.; located on Beryl Rd.

The eight-acre NCSU Arboretum, displaying about 5,000 kinds of trees, shrubs, vines, flowering plants, ground covers and grasses, was begun in 1976. Highlights include a home-landscape idea garden and a 300 ft.–long perennial border.

The Horticultural Science Greenhouses and Conservatory (open Mon.–Fri. 8–12 and 1–5; 919-737-3131), on the NCSU campus behind Kilgor Hall, is the University's teaching and research greenhouse (30,000 sq. ft.). Here the public may see over 900 species, including peperomia, cryptanthus and miniature-ivy collections.

Orton Plantation Gardens

RFD 1 **(919) 371-6851**
Winnabow, NC 28479

Hours: Mar.–Aug., every day 8–6; Sept.–Nov., 8–5.
Admission: fee charged.
Directions: 18 mi. south of Wilmington on State Hwy. 133.

Orton Plantation Gardens encompass 20 acres surrounding Orton House, a southern antebellum mansion. Live oaks, magnolias, cypress and pine trees are emphasized, and spacious lawns and ponds provide settings for thousands of azaleas, camellias and annuals. The Gardens opened to the public in the mid-1930s.

Old Salem, Inc.

Drawer F, Salem Station **(919) 723-3688**
Winston-Salem, NC 27108

Hours: Mon.–Sat. 8:30–4:30; closed Dec. 25.
Admission: fee charged.
Directions: located in downtown Winston-Salem, off I–40.
Public Transportation: accessible by bus.

Old Salem, a Moravian congregation-town restoration, covers 40 acres and features nine buildings dating from 1760 to 1840. The various structures are filled with period furnishings and household items, and are set in a re-created 18th-century landscape with gardens. Heirloom fruit trees, grapes, roses and shrubs, as well as old varieties of annuals, bulbs, perennials, vegetables and herbs—all authentic to the time—are grown in the Family Gardens. Altogether, about 1,000 kinds of plants embellish the restored landscape.

The historic value of the site was recognized in 1947, and as a means of preserving and restoring it, Old Salem, Inc., a not-for-profit organization, was established.

Reynolda Gardens of Wake Forest University

100 Reynolda Village **(919) 761-5593**
Winston-Salem, NC 27106

Hours: grounds, every day sunrise-sunset; greenhouses and Conservatory, Mon.–Fri 9–3, open weekends for special shows; Reynolda House, Tues.–Sat. 9–4:30, Sun. 1–4:30.
Admission: Gardens, no fee; Reynolda House, fee charged.
Directions: adjacent to Wake Forest University campus; from I–40 take Silas Creek Pkwy. north; right (east) at Reynolda Rd.; enter Reynolda Village main entrance.

Reynolda Gardens, 129 acres of formal and "natural" plantings, were built in 1916 as part of the estate of R.J. Reynolds, founder of the Reynolds Tobacco Company. They were donated to Wake Forest University between 1958 and 1962 by the Mary Reynolds Babcock Foundation.

Four-and-a-half acres of formal gardens fronting the Conservatory feature plantings of boxwood, annual and perennial beds. The grounds' central axis leads through the Upper Gardens which contain vegetables, fruits, flowers for cutting and an All-America Rose Garden. The third area, the Greater Gardens, is 125 acres of open fields and natural woodland. A wide variety of native flora and wildlife may be viewed on the nature trail leading to Lake Katherine. The Lord and Burnham Conservatory (dating from 1912) displays a variety of tropical plants, and Reynolda House shelters a collection of American art.

North Dakota

International Peace Garden

Dunseith, ND 58329 **(701) 263-4390**
P.O. Box 419
Boissevain, Manitoba
Canada ROK OEO

The International Peace Garden, dedicated in 1932, commemorates over 150 years of peaceful relations between the U.S. and Canada. The 2,400-acre site boasts scenic drives, nature trails through wooded lake country, an arboretum maintained by the

Manitoba Horticultural Association and formal gardens that include a floral clock. Additional highlights are fountain displays and plantings of roses and All-America annuals. Structures of interest include the Peace Tower, Carillon Bell Tower, Peace Chapel, Amphitheater, Lodge, Legion Athletic Camp and Masonic Auditorium. The Willis Centennial Pavilion, with exhibits and dining facilities, serves as a visitor center.

The Professional Grounds Management Society was the Peace Garden's founding organization.

Ohio

Stan Hywet Hall and Gardens

714 North Portage Path **(216) 836-5533**
Akron, Oh 44303

Hours: Tues.–Sat. 10–4; Sun. 1–4; closed Mon. and major national holidays.
Admission: fee charged.
Directions: twenty minutes south of the Ohio Turnpike (exits 11 or 12), via I–77, Rt. 8, I–71 or I–271; these all intersect with Rt. 18 (Market St.); Portage Path runs north off Rt. 18.

Stan Hywet Hall, a 65-room manor house of Tudor Revival style, surrounded by 70 acres of gardens, meadows, woods and lagoons, was originally designed by landscape architect Warren Manning. The estate was built in 1915 by Frank A. Seiberling, founder of the Goodyear and Seiberling Rubber Companies. After his death in 1955, his heirs, along with Akron Civic leaders, formed a foundation to operate the Hall as a self-supporting museum and cultural center. It is listed in the National Register of Historic Places and is a National Historic Landmark.

The forty acres of the grounds under intensive cultivation include the Rose Garden, Peony Beds (300 varieties), Plum Tree Garden, Alpine Garden, Cutting Gardens, Daylily Beds and Grape Arbor. The tree-lined approach road borders the Great Meadow, a vast open space spotted with naturalized daffodils and 20,000 tulips in spring and 10,000 chrysanthemums in late summer. The restored greenhouses and conservatory stand at the edge of the Gardens. Inside the Hall, rooms are appointed with Stuart and Tudor funishings.

Cemetery of Spring Grove

4521 Spring Grove Ave. **(513) 681-6680**
Cincinnati, OH 45232

Hours: grounds, every day 8–5; office, Mon.–Fri. 8–4:30, Sat. 8–noon; Memorial Mausoleum, every day 10–4.
Admission: no fee.
Directions: Four mi. north of downtown Cincinnati; 1 mi. west of I–75; take Mitchell Ave. exit west to the first intersection; turn left onto Spring Grove Ave.; ½ mi. to main entrance.

Civic Garden Center of Greater Cincinnati and The Hauck Botanic Garden

2715 Reading Rd. **(513) 221-0981**
Cincinnati, OH 45206

Hours: Garden Center, Tues.–Sat. 9–3; closed major holidays and Dec. 20 to Jan. 20; Hauck Botanic Garden, Mon.–Fri. 10–4.
Admission: no fee.
Directions: two blocks from I–71; William Howard Taft exit to Reading Rd.; one block north.
Public Transportation: accessible by bus.

Krohn Conservatory

Eden Park **(513) 352-4090**
Eden Park Dr. **352-4091**
Cincinnati, OH 45202 **(tour reservations)**

Hours: Mon.–Sat. 10–5, Sun. 10–6; Easter Sunday 7 a.m. to 10 p.m.; Easter week and Dec. 25 10 a.m. to 9 p.m.; Gift Shop, every day 10–5, closed holidays.

Kingwood Center, Mansfield, Ohio

Admission: no fee.
Directions: from downtown, 2 mi. northeast of Gilbert Ave.; turn into Eden Park; about 1 mi. on Eden Park Dr. to Conservatory. East on U.S. 50, exit Martin St. to Eden Park Dr.; Conservatory is at the corner of Martin St. and Eden Park Dr.; from I–71 (north or south), exit at Elsinor Ave. or Florence Ave. and follow signs.

With nearly 24,000 sq. ft. under glass, the Krohn Conservatory, offering a tour of a tropical rain forest, is Cincinnati's horticultural showcase. In addition to permanent displays of palms, cacti, citrus trees, ferns and orchids in naturalistic settings, six seasonal floral shows are staged annually.

The Conservatory opened in 1933 as a facility of the Cincinnati Park Board.

Mt. Airy Arboretum

5083 Colerain Ave. **(513) 541-8176**
Cincinnati, OH 45239

Hours: every day 7:30–sunset.
Admission: no fee.
Directions: I–75 to I–74 west; exit at Colerain Ave.; 1 mi. north on Colerain to entrance of Mt. Airy Forest; follow signs to Arboretum.
Public Transportation: accessible by bus.

Mt. Airy Arboretum is made up of 120 acres planted with more than 1,200 different species. Its collection of trees and shrubs includes ash, birch, beech, buckeye, cherry, crabapple, deutzia, dogwood, elm, euonymus, fir, hawthorn, hemlock, juniper, lilac, magnolia, maple, oak, poplar, spruce, viburnum, willow and yew. Outstanding displays are those of dwarf conifers, perennials and azaleas. A number of specialty gardens punctuate the landscape: the Meyer Lake and Rara Flora Garden, with rare and unusual plantings around the one-acre lake; the Garden of the Rhododendron and the Braam Memorial Garden, featuring azaleas and rhododendrons; and the Green Garden, emphasizing demonstration plantings of shrubs, ground covers, vines and herbs.

The Mt. Airy Arboretum was established in 1932 by the Cincinnati Park Board, with help from the National Federation of Garden Clubs. It is located within the 1,466 acres of Mt. Airy Forest, Cincinnati's largest park.

Cemetery of Spring Grove, Cincinnati, Ohio

Garden Center of Greater Cleveland

11030 East Blvd. **(216) 721-1600**
Cleveland, OH 44106

Hours: gardens, every day all hours; building, Mon.–Fri. 9–5, Sun. 2–5, closed Sat., except for special events.
Admission: no fee.
Directions: in the University-Circle section of Cleveland.
Public Transportation: accessible by bus.

The Garden Center of Greater Cleveland, founded in 1930 by members of the Garden Club of Cleveland, is the oldest civic garden center in the U.S. The four-acre site features four distinct gardens: the Herb Garden, maintained by the Western Reserve Herb Society, and considered "one of the largest and most beautiful . . . in the country;" the Rose Garden, planted with both new and old varieties; the Reading Garden, an extension of the library; and the Wick Perennial Borders.

The Chadwick Arboretum

Ohio State University **(614) 422-9775**
2001 Tyffe Court
Columbus, OH 43210

Admission: no fee.
Directions: I–70 to 315 north; right on Lane Ave., then right on Tyffe Rd.

Established on the Ohio State University campus in 1981, the Chadwick Arboretum's 40 acres contain some plant specimens over 100 years old. Major development, including new plantings, is set for 1987 and beyond. Construction of the Arboretum Lake was recently completed.

Cox Arboretum

6733 Springboro Pike **(513) 434-9005**
Dayton, OH 45449

Hours: grounds, every day 8–dusk; offices, Mon.–Fri. 8–4:30, weekends 9–1; shop, Mon.–Fri. 10–4, Sat., 10–2, Sun. 12–3.
Admission: no fee.
Directions: one mi. north of Dayton on Rt. 741 (Springboro Pike).

Public Transportation: accessible by RTA #19 bus.

Cox Arboretum has been developing plant collections on 170 acres since 1964. Managed by the Dayton Montgomery County Park District, the Arboretum was founded in 1962 by James Cox, Jr. Specialized areas include the Rock Garden, Herb Collection and Shrub Garden where examples (emphasizing viburnums) are arranged alphabetically around the South Pond. Other highlights include crabapples, deciduous shade trees (eventually covering 40 acres), evergreens on Conifer Hillside and, in the Woodland, mature specimens of native hardwoods, such as beech, oak, hickory, maple and ash. Floral displays of bulbs, daylilies, hostas, peonies and wildflowers complement the woody collections. The greenhouses (20,000 sq. ft.) shelter ivy (*Hedera helix*), scented geraniums, African violets and succulents.

Stanley M. Rowe Arboretum

4500 Muchmore Rd. **(513) 561-7340**
Indian Hill, OH 45243

Hours: dawn–dusk.
Admission: no fee.
Directions: U.S. 50 to Miami Ave. in Mariemont; north on Miami to Muchmore Rd.; right on Muchmore to driveway straight ahead.

The Rowe Arboretum sits on 40 acres that once made up the private estate of Stanley M. Rowe. Started in 1926, it now contains about 900 labeled species. These include extensive collections of crabapples, conifers and lilacs. Other plant groups featured are oaks, magnolias, viburnums, late-summer-blooming trees and shrubs and variegated ornamentals.

Kingwood Center

900 Park Ave. West **(419) 522-0211**
Mansfield, OH 44906

Hours: greenhouse and grounds, every day 8–sundown; mansion, Tues.–Sat. 9–5, Sun. (Easter–Oct.) 1:30–4:30.
Admission: no fee.
Directions: I–71 south (from Cleveland) to Rt. 30W exit; left on Trimble Rd., then left on Park Ave. W.; I–71 north (from Columbus) to Rt. 13N exit; left on Cook Rd., right on Trimble Rd. and right on Park Ave. W.

Kingwood Center is 47 acres of formal, informal and "natural" gardens. Spacious lawns, shaded by mature trees and adorned with flower beds, surround Kingwood Hall, the former residence of the late Charles K. King. Formal gardens feature fountains, statuary and clipped hedges. Specialty areas include the Herb, Rose, Perennial, Daylily (testing 300 varieties) and Iris (300 kinds) Gardens. A greenhouse-orangerie complex of six houses (9,000 sq. ft.) offers an indoor light garden, seasonal floral displays and permanent collections of cacti, succulents and orchids.

Charles K. King, one-time president of the Ohio Brass Company of Mansfield, died in 1952, leaving Kingwood with an endowment for its development and maintenance as a public attraction. The Center opened in 1953.

Holden Arboretum

9500 Sperry Rd. **(216) 946-4400**
Mentor, OH 44060

Hours: Tues.–Sun. 10–5; closed Dec. 25 and Jan. 1.
Admission: fee charged.
Directions: five mi. southeast of I–90 and Rt. 306 interchange.

The Holden Arboretum, containing over 7,000 accessioned plants on 2,900 acres, is dedicated to woody-plant research and education. More than half of the acreage is an undisturbed nature preserve. Natural habitats include a succession field, young forest, mature woods, oak-hickory, beech-maple and beech-hemlock forests, bog, creek and ravines. Popular collections are the Wildflower Garden, Dogwood and Crabapple Collections, Rhododendron Garden and Lilac Display Garden. Over 20 miles of trails wind among the plantings and natural woodland.

Provision for the Arboretum was originally made in 1912, through a trust set up by Albert Holden.

The Dawes Arboretum

7770 Jacksontown Rd. S.E. **(614) 323-2355**
Newark, OH 43055

Hours: every day during daylight; closed Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: no fee.
Directions: five mi. south of Newark on Rt. 13; three mi. north of I–70 (Rt. 13) exit 132; 45 minutes from downtown Columbus.

Of the Dawes Arboretum's 950 acres, the 350 that are open to the public display about 2,000 kinds of woody plants. Designated areas include the Flowering Crabapple Collection, Pine Family Collection, Maples, Oak Collection, Hawthorns, Hollies, Rhododendrons, Azalea Glen, Magnolias, Honey Locusts, Birches, Walnuts, Bald-Cypress Swamp, Dwarf Conifer Collection and Fastigiate Trees.

The Arboretum was founded in 1929 by the Dawes family.

Gardenview Horticultural Park

16711 Pearl Rd. (Rt. 42) (216) 238-6653
Strongville, OH 44136

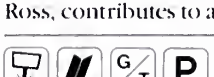
Hours: Mar. 1 to Nov. 1, weekends 12–6; groups any time by appointment; open to members at all times.

Admission: fee charged.

Directions: on Rt. 42, 1½ mi. south of Rt. 82; 18 mi. from Cleveland's Public Square.

Six acres of display gardens and a 10-acre arboretum comprise the principal elements of Gardenview Horticultural Park. Established in 1949, Gardenview represents the efforts of its founder, Henry A. Ross. After acquiring 16 acres of vacant land, he worked for the next 14 years developing the gardens. In 1961 he established a foundation to operate the installation.

Gardenview's specialized plantings include: the Spring Garden with tulips, daffodils, azaleas and crabapples; Shade Plants (early spring bulbs and hostas); Rose Gardens; Perennial Beds containing daylilies, iris, peonies and rhododendrons; and two ponds—one for water lilies, the other for waterfowl. Thousands of daffodils and 2,000 flowering and ornamental trees are featured in the Arboretum. Among these, a collection of over 500 varieties of crabapples, some developed by Ross, contributes to a spectacular spring show.



Inniswood Botanical Garden and Nature Preserve

940 Hempstead Rd. (614) 895-6216
Westerville, OH 43081

Hours: Tues.–Sat. 8–4:30, Sun. 12–5.
Admission: no fee.
Directions: from I–270, exit north towards Westerville, onto Westerville Rd.; right at Schrock Rd. (runs into Inniswood); right at entrance, on Hempstead Rd.

Inniswood, formerly the 37-acre estate of sisters Grace and Mary Innis, became the nucleus of a 91-acre Park District when it was donated by Grace in 1972. Fifty-four acres of woodland were added later.

Major plantings include peonies, bearded iris, daylilies, hostas and naturalized drifts of daffodils. A stone-wall rock garden features alpine plants. Trails lined with wildflowers wind through woodlands.

Secrest Arboretum

Ohio Agricultural Research and Development Center (216) 263-3761
Wooster, OH 44619

Hours: every day dawn–dusk.
Admission: no fee.
Directions: one mi. south of Wooster; Hwy. 250 to Ohio Agricultural Research and Development Center; follow Williams Rd. 1 mi. east.

The Secrest Arboretum, a part of the Ohio Agricultural Research and Development Center, is an 85-acre test and display facility for trees and shrubs (2,000 kinds). Features include: the Rhododendron Display Garden, a naturalized planting of azaleas and rhododendrons; flowering crabapples; and native tree and shrub species. In addition, conifers, junipers, arborvitae and forest pines are emphasized. At this writing, more than 140 kinds of trees are being evaluated in the Shade Tree Plot.

The oldest plantings in the Arboretum were set out in 1903. Many of these were made by Edmund Secrest, one-time director of the Research Center, and to whom the Arboretum was dedicated in 1950.

Oklahoma

Will Rogers Horticultural Gardens

3500 NW 36th St. **(405) 943-3977**
Oklahoma City, OK 73112

Hours: every day, 8–sunset.
Admission: no fee.
Directions: at the intersection of I–44 and NW 36th St.

The Oklahoma City Parks and Recreation Department operates the Will Rogers Horticultural Gardens, a 17-acre installation founded in 1933. Featured among the Gardens are a collection of daylilies, the Iris Garden (360 varieties) the Rose Garden and the Peony Garden (68 varieties). Woody plantings include the Holly Collection, Native Tree Meadow, redbuds, crape myrtles, the Henry Walter Azalea Trail, ground covers and the Arboretum. Among the 900 species and varieties found in the last "is one of the largest collections of junipers in the country."

Other highlights are: a Memory Garden with plants of yesteryear, a Rock Garden, using the state's native rock, and a Nature Trail through undisturbed countryside. The Conservatory, built in the 1930s, houses orchids and other tropical plants.

Philbrook Art Center

2727 South Rockford Rd. **(918) 749-7941**
Tulsa, OK 71114

Hours: grounds, every day 7–5, except legal holidays; Museum, Tues.–Sat. 10–5, Sun 1–5.
Admission: no fee.
Directions: located 3 mi. southeast of downtown Tulsa; I–44 to Peoria St. exit; follow north for 2¼ mi. to 27th Pl.; turn right, one block to Rockford Rd.

Philbrook Art Center, Tulsa, Oklahoma

Tulsa Garden Center, Inc.

2435 South Peoria St. **(918) 749-6401**
Tulsa, OK 74114

Hours: headquarters, weekdays 9–4.
Admission: no fee.
Directions: located in the Woodward Park complex, at 21st and Peoria Sts., near the Utica Square Shopping Center.
Public Transportation: accessible by city bus from downtown.

In 1954 an Italianate mansion (built by an oil baron in 1919) became the Tulsa Garden Center, a meeting place for horticulturists and garden groups. The grounds' ten acres contain a four-acre arboretum, sunken garden and conservatory. Neighboring the Center is Woodward Park, with extensive plantings of azaleas, a rock garden, waterscapes, rustic bridges and test gardens for roses, iris and chrysanthemums.

Oregon

Crystal Springs Rhododendron Garden

SE 28th Ave. **(503) 771-8386**
Portland, OR 97202

Hours: every day dawn–dusk.
Admission: no fee.
Directions: located in southeast Portland, adjoining the Eastmoreland Golf Course and adjacent to Reed College.
Public Transportation: accessible by Portland TriMet bus system.

Crystal Springs was started around 1950 by the American Rhododendron Society as a test site for rhododendrons. Today, the Garden displays over 300 rhododendron species, 400 cultivars and companion plants in a woodland setting.

Hoyt Arboretum

4000 SW Fairview Blvd. **(503) 228-8732**
Portland, OR 97221

Hours: grounds, every day 6–12; Visitor Center, 10–4.
Admission: no fee.
Directions: from downtown Portland, Hwy. 26W to the Zoo–OMSI exit; follow the main road through the zoo parking lot; right on Fairview Blvd.
Public Transportation: accessible by TriMet Bus #63.

Hoyt Arboretum sits atop a ridge of the Tuality Mountains. Its 200 acres are planted with over 700 species of trees and shrubs (grouped according to botanical family) amid native vegetation. Conifers, including notable redwoods, are represented by 230 species. Oaks, maples and magnolias are other extensive collections. Over ten miles of trails enable visitors to tour while viewing the city and distant mountains.

The Arboretum was established in 1928 when the City of Portland purchased the land on which it was developed.

International Rose Test Garden, Washington Park

400 SW Kingston St. **(503) 796-519**
Portland, OR 97201 **248-430**

Hours: every day, 6–12.
Admission: no fee.
Directions: I–5 to the Fremont Bridge to 18th; right at West Burnside, left at Kingston.
Public Transportation: accessible by TriMet Bus #63.

The Japanese Garden

The Japanese Garden **(503) 223-1321**
Society of Oregon **223-4070**
P.O. Box 3847
Portland, OR 97208

Hours: Sept. 16 to Apr. 14, every day 10–4; Apr. 15 to Sept. 15, 10–6; closed Thanksgiving Day, Dec. 25 and Jan 1.
Admission: fee charged.
Directions: located in Washington Park, off Kingston Ave., above the International Rose Test Garden; signs on West Burnside direct the way to the Garden.
Public Transportation: accessible by TriMet Bus #63.

The Japanese Garden, situated on 5½ acres, encompasses five distinct gardens: in the Flat Garden, plants, rocks and raked white gravel form a design meant to be viewed from the Japanese-style pavilion veranda; nearby is the Sand and Stone Garden, a rectangular space enclosed by a wall; in the Natural Garden, shallow streams, waterfalls and native plants may be enjoyed from a winding path; the Strolling Pond Garden, the largest in the complex, features waterfalls, ponds, rocks and lush plantings; the Tea Garden contains a teahouse that was brought to Portland from Japan. Along with the various Japanese-design elements, about 400 kinds of plants are on view in these gardens.

Land for The Japanese Garden was set aside in 1961, and soon after, Professor P. T. Tono was selected to execute its design. It opened to the public in 1967.

G/T P

Pennsylvania

The Henry Foundation for Botanical Research

P.O. Box 7 **(215) 525-2037**
801 Stony La.
Gladwyne, PA 19035

Hours: April–Oct., Tues. and Thurs. 10–4; other times by appointment.
Admission: no fee.
Directions: Schuylkill Expwy. (I–76) west to Gladwyne exit; left off ramp to Rt. 23 (Conshohocken St.); right at 23; after 2 mi. right at Henry La., left at Stony La.; entrance is on right.

The Henry Foundation is dedicated to the collections and preservation of choice American native plants. The 10-acre site contains a rare-plant assemblage that is the result of forty years of travel by Mary G. Henry, the founder of the garden. The plants are grown in naturalized settings amid rock outcroppings. Emphasized collections include *Rhododendron, Styrax, Halesia, Magnolia, Lilium, Vaccinium, Ilex* and *Chionanthus.*

G/T P

Bowman's Hill Wildflower Preserve, Washington Crossing, Pennsylvania (photo: Professor Al List, Jr.)

Haverford College Arboretum

The Campus **(215) 896-1101**
Arboretum Association
Haverford College
Haverford, PA 19041

Hours: every day dawn–dusk.
Admission: no fee.
Directions: from Philadelphia, Schuylkill Expwy. (I–76) west to exit marked Rt. 1 south, City Ave.; after 2½ mi., right at Lancaster Ave. (Rt. 30); continue to Haverford; Haverford College is on left, with sign marking entrance.
Public Transportation: accessible by Septa Bus or Paoli Local to Haverford Station.

Hershey Gardens

621 Park Ave. **(717) 534-3492**
Hershey, PA 17033

Hours: Apr., May and Sept. through Dec., every day 9–5; Memorial Day through Labor Day, every day 9–7.
Admission: fee charged.
Directions: located in Hershey, adjacent to the Hotel Hershey; Interstate Hwys. 76, 78, 81 and 83 and PA Rts. 322, 422, 39 and 743 lead to Hershey; once there, follow signs to Hotel Hershey and Hershey Gardens.

Hershey Gardens, established in 1936, comprise 23 acres of seasonal flower displays, collections of specimen trees and shrubs, theme gardens and a Rose Garden that contains nearly 14,000 plants of some 800 varieties. These include All-America Selections and some specimens over 45 years old.

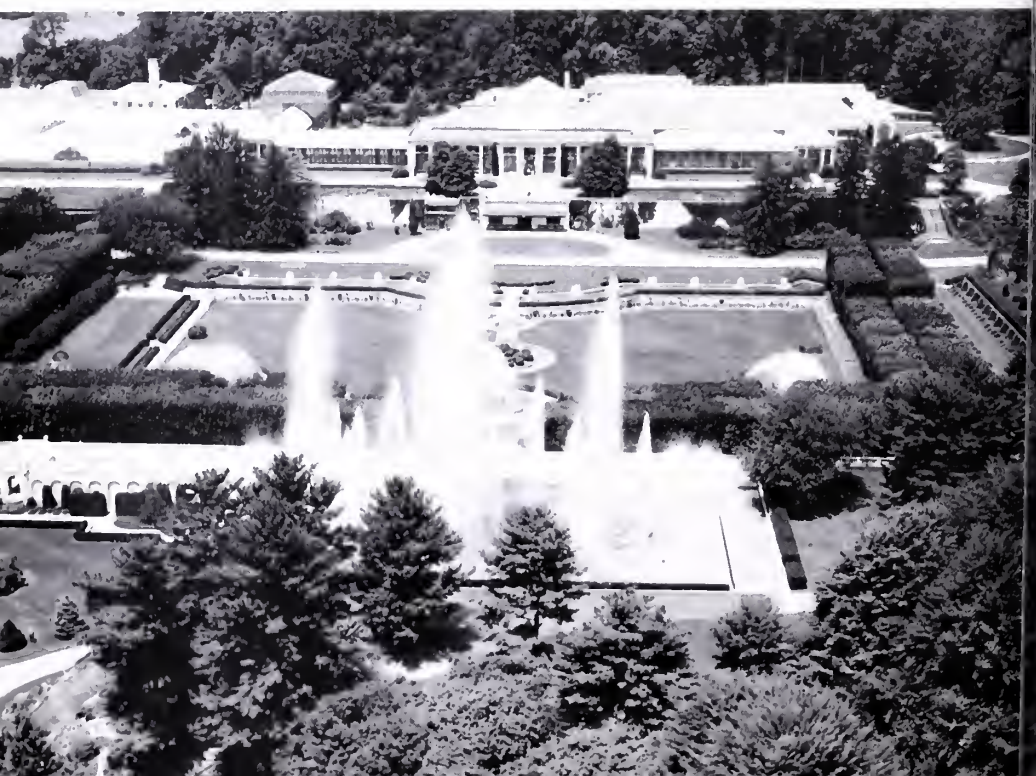
Featured collections include hollies, Japanese maples, dwarf and weeping conifers, magnolias and flowering cherries, crabapples, pears and plums.

Longwood Gardens

P.O. Box 501 **(215) 388-6741**
Kennett Square, PA 19348

Hours: gardens, Apr.–Oct., every day 9–6; Nov.–Mar., every day 9–5; conservatories, every day 10–5; Peirce-du Pont House, Apr.–Nov., every day 11–3.
Admission: fee charged.
Directions: 30 mi. west of Philadelphia on U.S. 1; 12 mi. north of Wilmington, DE (Rt. 52 to U.S. 1); 3 mi. northeast of Kennett Square via U.S. 1.

Longwood Gardens' main fountains and conservatories, Kennett Square, Pennsylvania (photo: Longwood Gardens)



One of America's outstanding horticultural display facilities, Longwood Gardens cover 1,000 acres. Of these, 350 are devoted to outdoor gardens and 3½ are under glass. More than 20 greenhouses are open to the public and some 11,000 kinds of plants are grown indoors and out.

Outstanding features include: the Conservatories—some with changing displays, others with permanent collections: the extravagant fountains, with illuminated evening shows; the outdoor theater; one of the world's largest pipe organs; and the Peirce-du Pont House. Specialty gardens are Flower Garden Walk, Hillside Garden, Italian Water Garden, Topiary Garden, Idea Garden, meadow and collections of bonsai and aquatic plants.

Seasonal displays at Longwood number November's Chrysanthemum Festival, the Christmas show of poinsettias and illuminated trees, and a summer display of waterlilies. Year-round attractions include orchids and roses in the greenhouses, and palms, economic plants, cacti, ferns and tropical pitcher plants in the Conservatories.

The Peirce-du Pont House on the grounds dates back to 1730. Descendants of the Peirce family planted the oldest trees on the property, and the grounds became a local attraction in the 1800s. In 1906 Pierre S. du Pont, who would become chairman of the Du Pont Company and General Motors, purchased the property to save the trees. He started construction of the massive conservatory structures in 1918 and they opened to the public in 1921.

The John J. Tyler Arboretum

P.O. Box 216
Lima, PA 19037
(215) 566-9133

Hours: every day 8–5; longer hours during warm months.
Admission: fee charged.
Directions: I–95 to Rt. 452 west to Barren Rd.; left at Painter Rd.

Two hundred of the 700 acres open to the public at the Tyler Arboretum form a display of woody plants, including trees started in the 1850s. Major collections are the Swarthmore hybrid rhododendrons developed by Dr. John C. Wister, Oriental cherries, crabapples, magnolias, lilacs, dwarf conifers and deciduous shade trees. Other highlights include the native plant trail, fragrant garden and bird-habitat garden. The remaining 500 acres comprise a natural preserve, featuring 20 miles of hiking trails.

The Arboretum was established in 1946 when Laura H. Tyler bequeathed the property in memory of her husband.

Swiss Pines

Charlestown Rd.
R.D. 1, P.O. Box 127
Malvern, PA 19355
(215) 933-6916

Hours: Mon.–Fri. 10–4; Sat. 9–11; closed holidays and Dec. 15–Mar. 15.

Admission: no fee.

Directions: located near the Pennsylvania Tpke. (I–276) overpass at Rt. 29; from Malvern, Rt. 30 onto Rt. 29; under Tpke. overpass, straight ahead on Charlestown Rd.; from Phoenixville, take Nutt Rd.; right at Bridge Rd.; Bridge Rd. becomes Charlestown Rd.

Swiss Pines is best known for the Japanese-style gardens, pavilions and ornaments that occupy much of its 19 acres. The Teahouse and Tea Garden, stone garden, lake, streams, bridges, statuary and stone lanterns, amid naturalistic plantings, all contribute to the Oriental atmosphere.

Specialty plant collections include: the Glendale Azalea Garden (150 kinds); the Herb Garden, designed for low maintenance and containing 100 species; the Ground Cover Garden (28 low-growing plants); and the Pinetum (over 200 kinds of conifers).

Arnold and Meta Bartschi, the originators of Swiss Pines' Japanese design, donated their garden to a foundation in 1960.

Arboretum of the Barnes Foundation

P.O. Box 128 **(215) 664-8880**
Merion Station, PA 19066

Hours: Mon.–Sat. 9:30–4, Sun. 1:30–4; closed holidays.
Admission: no fee.
Directions: Schuylkill Expwy. (I–76) to City Ave. exit; south 2 mi., right at Lapsley La.; from intersection of Rt. 30 and Rt. 1, north 1 mi., left at Lapsley La.
Public Transportation: accessible by train or bus from Philadelphia.

Aside from its primary objective of providing courses for those interested in botany, horticulture and landscape architecture, the Arboretum of the Barnes Foundation offers a diverse collection of woody plants for the enjoyment of the public. These include examples of maples, hollies, oaks, viburnums and lilacs. Other features are a three-acre woodland, a dwarf conifer collection, rose, rock and heath gardens, and the Edgar T. Wherry Memorial Garden.

Bartram's Garden

54th St. and Lindbergh Blvd. **(215) 729-5281**
Philadelphia, PA 19143

Hours: Garden, every day dawn–dusk; house, May–Oct., every day 10–4, Nov.–Apr., Tues.–Fri. 10–4, closed holidays.
Admission: fee charged for house only.
Directions: I–76 east to University Ave. exit (left); right at Gray's Ferry Ave.; left at Paschall St.; left at 49th St.; bear right onto Gray's Ave.; at next fork, left onto Lindbergh Blvd.; after 54th St., left at Bartram La.
Public Transportation: trolley #36 from City Hall stops at entrance.

Forty-four acres of John Bartram's colonial estate, including the 18th-century stone farmhouse he designed and largely built himself, form the historic site subtitled "America's Oldest Surviving Botanic Garden." As a colonial botanist, Bartram (1699–1777) explored the flora of eastern North America, transplanting discoveries to his own land and shipping specimens across the Atlantic. In this way, he introduced many native American plants to Europe.

Today, on 27 acres open to the public, the Garden displays the plants Bartram collected. Only those grown by him or his son William have been replanted. The house looks out on the Common Flower Garden; to the north stands the stone "Seed House," which Bartram used to store the plants he intended to ship to Europe.

The historic site is administered by the John Bartram Association (founded in 1893 by 400 of his descendants).

Swan Pond, Morris Arboretum, Philadelphia, Pennsylvania

The Horticulture Center

North Horticultural Dr. **(215) 879-4062**
West Fairmount Park
Philadelphia, PA 19131

Hours: Wed.–Sun. 9–3.
Admission: donation requested.
Directions: Schuylkill Expwy (I–76) to Montgomery Dr. exit, travel west; North Horticultural Dr. is the first road to the left.
Public Transportation: bus #38 from center-city Philadelphia.

The Horticulture Center features a 31,000 sq-ft. greenhouse, seven formal demonstration gardens, the 22-acre Centennial Arboretum and a 13th century-style Japanese House and Garden. The Arboretum contains specimen trees and shrubs, some of which date from the Centennial Exhibition of 1876. The demonstration Gardens provide urban dwellers with ideas for small garden plots. The Japanese House, built in Japan, was added to the site in 1953, and the Garden was installed later by Japanese designers.

Morris Arboretum of the University of Pennsylvania

9414 Meadowbrook Ave. **(215) 247-5777**
Chestnut Hill
Philadelphia, PA 19118

Hours: June–Aug., every day, except Thurs., 10–5; Thurs. (June–Aug.) 10–8; Apr., May, Sept., Oct., every day 10–5; Nov.–Mar., every day 9–4.
Admission: fee charged.
Directions: located in northwest Philadelphia (Chestnut Hill), 5 mi. south of the Pennsylvania Tpke. (I–276).

The Morris Arboretum is a living museum of temperate woody plants, a historical garden, educational institution and research facility affiliated with the University of Pennsylvania. The one-time-private Victorian estate features 3,500 kinds of plants on 90 acres.

Laid out in a naturalistic style amid woodland and pasture, the Arboretum is composed of distinct areas connected by winding paths. Attractions include the Rose Garden (All-America Selections), Formal Parterres, Oriental Gardens, English Park, Azalea Meadow, Magnolia Slope, Oak Allee and Swan Pond. Structures sprinkled throughout the gardens date from the early 1900s. Many rare and notable tree collections include hollies, viburnums, Asian maples, witch hazels, cherries and stewartias.

John T. Morris and his sister Lydia acquired land in Chestnut Hill and began building their estate in 1887. When Lydia died in 1932, she bequeathed the property to the University of Pennsylvania as a public arboretum.

Phipps Conservatory

City of Pittsburgh **(412) 255-2376**
Schenley Park
Pittsburgh, PA 15213

Hours: every day 9–5, also 7–9 p.m during spring and autumn flower shows; closed two days prior to show openings.
Admission: fee charged.
Directions: located on Schenley Dr. in the Oakland section of Pittsburgh, five minutes from the city's downtown area.

Two and half acres of Pittsburgh's Schenley Park lie under the protective glass of the Phipps Conservatory. Winding through the 1893 Victorian structure's 13 connected greenhouses are almost a half mile of walkways. Some of the palms in the central house, the Palm Court, date from 1894 when they were acquired from the Chicago World's Exposition.

Other houses include: the Fern Room, with tree ferns and cycads; the Stove Room, a warm house; the Orchid Room, featuring orchids and bromeliads; the Desert House; the Victoria Room, with waterlilies and tropical trees; the Japanese Room; the Broderie Garden, with a 17th-century French-style embroidery garden; the Economic Room; and several Exhibition Houses featuring changing displays.

The Conservatory came about in 1892 as the result of a gift from steel magnate Henry Phipps. The various substructures, with sloped-glass domes, opened to the public the following year. Ever since they have been operated and maintained by the City's Department of Parks and Recreation.

The Scott Arboretum of Swarthmore College

Swarthmore College **(215) 447-7025**
Swarthmore, PA 19081

Hours: offices, Mon.–Fri. 8:30–4:30; grounds, every day sunrise–sunset.
Admission: no fee.
Directions: southwest of Philadelphia; I–95 to Chester, PA, exit; Rt. 320 north about 3 mi.; left at College Ave.; one block to Scott Arboretum.
Public Transportation: SEPTA train (Media local) stops at the campus; bus service from Philadelphia.

The Scott Arboretum, comprising 110 acres of Swarthmore College's landscape, provides a display of ornamental plants best suited to Delaware Valley gardens. Established in 1929 as a living memorial to Arthur Hoyt Scott through a bequest from his family, the Arboretum is made up of more than 5,000 kinds of plants spread throughout the campus. All have been selected for their superior ornamental qualities, ease of maintenance and resistance to disease.

Major collections include: Flowering Cherries, Corylopsis, Crabapples, Lilacs, Magnolias, Rhododendrons, Roses, Tree Peonies, Viburnums and Wisteria. Of special note is the James R. Frorer Holly Collection, with over 220 kinds.

Bowman's Hill Wildflower Preserve

Washington Crossing **(215) 862-2924**
Historic Park
Washington Crossing,
PA 18977

Hours: Mon.–Sat. 9–5, Sun. noon–5; buildings closed Jan. 1, Thanksgiving Day and Dec. 25.
Admission: no fee.
Directions: located on River Rd. (Rt. 32), 2½ mi. south of New Hope, PA.

Bowman's Hill Wildflower Preserve, established in 1934, is dedicated to the preservation and conservation of the native flora of Pennsylvania. Within a mile of the Delaware River, the Preserve's 100 acres displays wildflowers, ferns, shrubs, trees and vines in woodland settings along 26 trails. Wildflowers of particular horticultural merit are featured in the Headquarters Garden, and native trees dot Penn's woods, the nine-acre arboretum. Man-made habitats include the pond, sphagnum bog, limestone bluff and serpentine barrens.

Rhode Island

Blithewold Gardens and Arboretum

Ferry Rd. **(401) 253-2707**
Bristol, RI 02809

Hours: grounds, every day 10–4; mansion, May 1 to Oct. 31, 10–4, closed Mon. and holidays.
Admission: fee charged.
Directions: 2 mi. south of Bristol, on Rt. 114.
Public Transportation: accessible by bus.

Blithewold Gardens and Arboretum encompass a turn-of-the-century summer residence, with gardens and landscapes typical of the late 19th and early 20th centuries. Overlooking the Narragansett Bay, the 33-acre estate contains about 1,000 kinds of plants. Highlights of the landscape are: the Bosquet, a wooded area filled with ground covers and spring bulbs; the Rock Garden; the Water Garden; the North Garden, featuring blue- and yellow-flowering annuals and perennials; the Cutting Garden; and the Rose Garden.

The Preservation Society of Newport County, Newport, Rhode Island

Planted around 1900, many of the Arboretum's woody specimens are notably mature. These include Chinese cedar, ginkgo, Japanese tree lilac and a grove of bamboo. Blithewold also boasts the largest giant sequoia (80 ft. tall) east of the Rockies.

The Gardens, largely completed by 1895, were designed by John Dewolf. Originally owned by coal magnate Augustus Van Winkle, the estate was eventually inherited by his daughter Marjorie. When she died in 1976, Blithewold became the property of the Heritage Foundation of Rhode Island.

Green Animals

Location Address:
Cory's La.
Portsmouth, RI
(401) 683-1267

Mailing Address:
The Preservation Society of Newport County
118 Mill St.
Newport, RI 02840
(401) 847-1000

Hours: May–Sept., every day 10–5; Oct., weekends 10–5; holidays 10–5; at other times, groups of 20 or more (reservations required).
Admission: fee charged; combination tickets for the Newport Mansions (see previous entry) include Green Animals.
Directions: located on Cory's La. off Rt. 114, 0.3 mi. from the intersection of 114 and 24; next to St. Philomena's School and across from Portsmouth Abbey and School.

Green Animals is noted for its 80 animal-shaped topiaries. The seven-acre estate also includes: annual, perennial and rose beds in geometric patterns; fruits trees; herb garden; dahlia garden; vegetable garden; espaliered fruit trees; magnolias; gourd and grape arbors; cold frames; and greenhouses. In the Formal Garden, geometric shapes are fashioned from California privet, golden boxwood, yew and

American boxwood. The menagerie of topiary animals includes a bear, boar, camel, dogs, donkey, elephant, giraffe, horse, lion, goat, ostrich, peacocks, rooster and swan.

The estate was bequeathed to The Preservation Society of Newport County in 1972.

Newport Mansions

The Preservation Society of Newport County **(401) 847-1000**
118 Mill St.
Newport, RI 02840

Hours: vary with each mansion; call for information.
Admission: varies with each mansion; a variety of reduced-rate combination tickets are available; for reservations, call 847-6543.
Directions: located in the Bellevue area of Newport.

A group of lavishly constructed mansions sited along the Atlantic coastline are jointly operated and maintained by the Preservation Society of Newport County. The structures span a time period of 1748 to 1902 and are notable for the magnificence of their mature plant specimens.

Wilcox Park

17 ½ High St. **(401) 348-8362**
Westerly, RI 02891

Hours: every day, all times.
Admission: no fee.
Directions: Rt. 1 into Westerly; Park is in the heart of the village.

Wilcox Park, designed by Warren H. Manning, former associate of Frederick Law Olmsted, was established in 1898. Plants native to the region dominate its gardens, but in the 1960s efforts were begun toward the development of the Park as an arboretum, and new installations were made accordingly. Specialty areas include the Dwarf Conifer Garden (in a rock-strewn setting), Herb Garden, Garden of the Senses and Perennial Garden. Wilcox also contains examples (a fountain, lily pond and bandstand) of the fine granite work for which the region was once known. The Park was placed on the National Register of Historic Places in 1973.

South Carolina

Magnolia Plantation and Gardens

Rt. 4, Hwy. 61 **(803) 571-1266**
Charleston, SC 29407

Hours: every day 8–6; closed Dec. 25.
Admission: fee charged.
Directions: located on Hwy. 61, 10 mi. south of Charleston; 14 mi. from Summerville.

Magnolia Plantation and Gardens, on the National Register of Historic Places, began in the late 1600s as an estate plantation. Reaching an exceptional degree of maturity in the years since, its 50 acres of gardens feature masses of azaleas, camellias (over 500) and magnolias under a canopy of live oaks and cypress. Bounded by the Ashley River, the 500-acre property is owned and operated by ninth-generation descendants of its original owners.

Plantings in relatively recent years include the 18th century-style herb garden and 17th century-style maze. Bordering the Gardens and cutting through the 125-acre waterfowl refuge are five miles of nature trails.

Middleton Place

Ashley River Rd. **(803) 556-602**
Charleston, SC 29407

Hours: grounds, every day 9–5; House, closed Mon. mornings and two weeks in mid-winter.
Admission: fee charged.
Directions: located 14 mi. northwest of

Charleston on Hwy. 61 (Ashley River Rd.).

Middleton Place, a National Historic Landmark, boasts the oldest landscaped garden (laid out by Henry Middleton in 1741) extant in America. Surrounding the restored Middleton Place House (built in 1755) and the Plantation Stableyards, the 100 acres of the garden open to the public feature over 200 kinds of plants, as well as numerous farm animals.

In the late 18th century, Andre Michaux planted America's first camellias at Middleton Place, and many of these can still be seen today; later additions form flowering canopies during the winter months. Massive live oaks, including the famous Middleton Oak (estimated to be several hundred years old), over 35,000 azaleas, southern magnolias and some of the largest crape myrtles in the country are other attractions.

The Middleton Place Foundation governs the historic site.

Brookgreen Gardens' Live Oak Allé, Murrells Inlet, South Carolina

Park Seed Company Gardens

Hwy. 254 North **(803) 374-3341**
Greenwood, SC 29647

Hours: Mon.–Fri. 8–4:30; closed holidays.
Admission: no fee.
Directions: located 0.5 mi. north of Greenwood on Hwy. 254 North.

The Park Seed Company Gardens constitute the largest trial garden for annuals in the southeast. On the five acres of the test and research facility open to the public, 500 kinds of spring bulbs and 1,500 to 2,000 varieties of summer annuals and perennials may be seen and compared. The Company was founded in 1868 by George W. Park.

Magnolia Plantation and Gardens, Charleston, South Carolina

Brookgreen Gardens

Hwy. 17 South **(803) 237-4218**
Murrells Inlet, SC 29576

Hours: every day 9:30–4:45; closed Dec. 25.
Admission: fee charged.
Directions: 17 mi. south of Myrtle Beach, 17 mi. north of Georgetown, on U.S. Hwy. 17.

Over 400 pieces of American 19th- and 20th-century sculpture are set among tranquil gardens, fountains, courtyards, allées, ponds and woodland at Brookgreen Gardens. On the 300 acres that form the Gardens proper, horticultural highlights include: the Dogwood Garden, divided into four quadrants, each with a pool; the Small Sculpture Gallery, enclosed in the manner of a cloister garden; the South Carolina Terrace; the Live Oak and Magnolia Allées; the Diana Pool; the Palmetto Garden, also with a reflecting pool; the Fountain of the Muses Garden, with pergolas and raised planting beds; the Arboretum; and Dogwood, Opuntia and Cypress Ponds. In direct contrast to the manicured formality of the

Memphis Botanic Garden, Japanese Garden, Memphis, Tennessee

sculpture gardens is Brookgreen's 50-acre wildlife park, with animals and native plants.

The Gardens were started—with the intent of sharing them with the public—by Mr. and Mrs. Archer M. Huntington in 1931. Brookgreen Gardens, Inc., A Society for Southeastern Flora and Fauna, was organized, and today the corporation administers the Gardens, wildlife park and collections.

Tennessee

Reflection Riding

Garden Rd. (Rt. 4) **(615) 821-1160**
Chattanooga, TN 37409

Hours: every day during daylight, except Sun. mornings.
Admission: fee charged.
Directions: located southwest of Chattanooga; turn south off Cummings Hwy. (U.S. 41) ¼ mi. west of Lookout Mountain; go 1 mi. on Garden Rd. (Rt. 4).

Reflection Riding is a 300-acre nature preserve, with a variety of native trees and shrubs, that may be enjoyed from numerous walking trails or over three miles of automobile roadway.

Mr. and Mrs. John Chambliss established Reflection Riding in 1956.

The Dixon Gallery and Gardens

4339 Park Ave. **(901) 761-2409**
Memphis, TN 38117

Hours: Tues.–Sat. 11–5, Sun. 1–5; closed Jan. 1, July 4, Labor Day, Thanksgiving Day, Dec. 24, 25 and 31.
Admission: fee charged, except on Tues.
Directions: located 9 mi. east of downtown Memphis; I–240 to Getwell exit north; right at Park Ave.; on the right within 1 mi.

An attraction for art and plant lovers alike, the Dixon Gallery and Gardens, open to the public since 1976, offer 17 landscaped acres and a collection of impressionist paintings. Margaret and Hugo Dixon began developing the estate in 1940. With the assistance of Mr. Dixon's sister, noted landscape architect Hope Crutchfield, and utilizing French cross-axis design, the Dixons created a garden reminiscent of English park settings. Vistas emphasize mature oaks, and walks feature ground covers, herbaceous plants and garden statuary.

Memphis Botanic Garden

750 Cherry Rd. **(901) 685-1566**
Memphis, TN 38117

Hours: grounds and gardens, every day 8–sundown; Goldsmith Civic Garden Center, Mon.–Fri. 9–5, weekends 1–5; closed major holidays.
Admission: no fee.
Directions: located in Audubon Park in east Memphis; near I–240 and Memphis State University.
Public Transportation: accessible by Memphis Area Transit Authority bus.

In the southeastern corner of Audubon Park (373 acres) are 120 acres that form the Memphis Botanic Garden. Over 2,000 kinds of plants may be found in its collections. Begun in 1953, the Garden is operated by the Memphis Park Commission.

Among the 15 specialized areas offered are: the Iris Garden, containing several hundred varieties on five acres; the Dahlia Garden; the Daylily Trial Garden; the Magnolia Garden, started in 1958, with many exotic species; the Conifer Garden; the Rose Garden, with 4,000 plants; the Wildflower Garden—over 300 species and varieties in a naturally wooded cove; the Azalea and Dogwood Trail, planted amid an oak forest; the Daffodil Trail; the Test Garden, where plants from the U.S.D.A. are observed; the Japanese Garden, surrounding Lake Biwa; the Cactus Garden; and the Perennial Garden.

Plants indigenous to the mid-South are emphasized in the woody collections, and the 3,000 sq-ft. conservatory displays about 500 kinds of tropicals.

Tennessee Botanical Gardens and Fine Arts Center at Cheekwood

Forrest Park Dr. **(615) 352-5310**
Nashville, TN 37205

Hours: Tues.–Sat. 9–5, Sun 1–5; closed Thanksgiving Day, Dec. 24, 25, 31 and Jan. 1.
Admission: fee charged.
Directions: located 8 mi. southwest of downtown Nashville; Broadway/West End Ave./Harding Rd. to Belle Meade Blvd.; left at Belle Meade; right at Page Rd.; left at Forrest Park Dr.; Cheekwood is at the top of Forrest Park Dr., on the right.
Public Transportation: two buses (Metropolitan Transit Authority) leave downtown Nashville to Belle Meade-Cheekwood daily; call (615) 352-5310.

Once the residence of Mr. and Mrs. Leslie Cheek, Cheekwood (built between 1929 and 1932) today functions as a display garden and fine arts center. Its 18th-century Georgian-style mansion and English-style landscape were designed by Bryant Fleming. In 1959 the Cheeks' daughter gave the 55-acre estate to a not-for-profit organization to maintain it as a cultural center for Nashville and the mid-South. It was opened to the public in 1960.

An ingenious system of artificial brooks, ponds, recycling fountains, cascading waterfalls and a collection of boxwood are survivors of the original landscaping. Several plant collections and gardens have been added to Cheekwood in the years since it became a public attraction: The Wills Garden, dedicated in 1981, displays iris and other perennials along winding paths; "Wildings," once the wildflower garden of Mrs. H.A. Howe, was transplanted to Cheekwood after her death in 1967; in the three circular areas of Burr Garden, roses, herbs and perennials are emphasized. A path through this section is bordered by 1,600 azaleas.

Other highlights include the Daffodil Garden, Herb Study Garden and Mustard Meadow, where the mustard indigenous to Nashville forms a yellow carpet in early April. Four greenhouses (5,000 sq. ft.) display orchids, camellias and, in the Cloud Forest Greenhouse, "a little piece of Central America"—bromeliads, other epiphytes and plants native to Central America re-creating a tropical environment.

University of Tennessee Arboretum

901 Kerr Hollow Rd. **(615) 483-3571**
Oak Ridge, TN 37830

Hours: grounds, every day 8–sunset; office, Mon.–Fri. 8–5.
Admission: no fee.
Directions: located 20 mi. west of Knoxville, 3 mi. south of Oak Ridge Tpke. (Rt. 61) on Rt. 62 (Kerr Hollow Rd.).

Two hundred and fifty of the 2,260 acres that make up the Tennessee Arboretum are open to the public. Woody collections include pines, magnolias, dogwoods and willows. The Arboretum serves as an official test facility for hollies, and boasts many rare and unusual dwarf conifers. In all, more than 700 kinds of trees and shrubs may be seen via a system of trails and roads.

Specialty areas include models of California, Southern Coastal Plain, Central China and Heather Forests, experimental plant screens and shade trees, a marsh and reflecting pond for moisture-loving plants.

The Arboretum was started in 1964 as a project of the Forestry Department.

Texas

Dallas Arboretum and Botanical Garden

8525 Garland Rd.
Dallas, TX 75218
(214) 327-8263

Business Office:
8617 Garland Rd.
Dallas, TX 75218
(214) 327-8263

Hours: gardens, Tues.–Sun. 10–6; DeGolyer House, Tues.–Fri. 10–4.
Admission: fee charged; no fee on Tues.
Directions: located in east Dallas on White Rock Lake; Garland Rd. is between I–635 and I–30.

Tennessee Botanical Gardens and Fine Arts Center at Cheekwood, Nashville, Tennessee

Public Transportation: accessible by city buses.

The Dallas Arboretum and Botanical Society is working on a master plan for two adjoining sites along White Rock Lake: the 22-acre Camp Estate and the 44-acre DeGolyer property. Under development is a collection of Texas trees, shrubs, vines and flowers, as well as plants native to the southwestern U.S. and other countries. The former estates have been graced with trails, walks, floral displays and testing/demonstration gardens. Restoration of the historic DeGolyer gardens began in 1985, and major renovation is underway.

The Dallas Arboretum and Botanical Society founded DABG in 1970.

Dallas Garden Center

P.O. Box 26194 **(214) 428-7476**
Dallas, TX 75226

Hours: Mon.–Fri. 10–5, weekends 9–5; closed Dec. 24, 25 and Jan. 1.
Admission: no fee.
Directions: located on Martin Luther King Ave. in the southwest corner of the State Fairgrounds; I–30 to Second Ave. exit, just south of downtown Dallas.
Public Transportation: accessible from downtown by city bus (ten-minute ride).

A series of small outdoor gardens and a 9,884 sq-ft. conservatory complex constitute the Dallas Garden Center's seven and a half acres. The multilevel outdoor areas include: the Callier Garden, with a fountain as its focus; the All-America Garden—colorful annuals in a geometric design; the Herbert Marcus Senior Garden, with a large turn-of-the-century Italian urn; the Josson Garden, featuring water and live oaks; the Shakespeare Garden; and the Herb and Scent Garden.

The contemporary conservatory complex houses about 450 varieties of tropical plants, including orchids and over 90 species of bromeliads. A free-standing waterfall provides gurgling sounds, and visitors may view the entire Tropical Room from a 16 ft.-high catwalk.

Fort Worth Botanic Garden

3220 Botanic Garden Dr. **(817) 870-7686**
Fort Worth, TX 76107

Hours: every day 8–11; Japanese Garden, Apr.–Oct., Tues.–Sat. 9–7, Sun. 1–7; Nov.–Mar., Tues.–Sat. 10–5, Sun.1–5; production greenhouses, Mon.–Fri. 8–3:45
Admission: fee charged for Japanese Garden only.
Directions: from the intersection of I–30 and I–35, travel west on I–30; left at University Dr. north exit; left at Botanic Garden Dr.
Public Transportation: accessible by city bus.

Construction of the Fort Worth Botanic Garden, underwritten with Federal Relief Funds, began in 1933 on 37 acres. Since then, its size has expanded to 114 acres, with over 2,000 kinds of plants in a variety of formal and informal settings.

Gardens include: the Rose Garden, with 3,500 plants; the Fragrance Garden; the Test Garden (All-America Selections of annuals and roses); and the seven-acre Japanese Garden, installed in the 1970s with a variety of gates, teahouses and pavilions. Other areas of interest are the arboretum, displaying over 150 kinds of trees, the cactus garden and the water garden, a series of lagoons at the site of the original Rock Springs. Informal plantings of azaleas and beds of annuals and perennials provide seasonal color. The Exhibition Greenhouse, adjoining the Garden Center, is filled with tropicals.

Fort Worth Water Gardens

Parks and **(817) 870-7699**
Recreation Department
1501 Commerce St.
Fort Worth, TX 76102

Hours: fountains run every day 12 noon to 10:30 p.m.
Admission: no fee.
Directions: located west of I–35W and

north of I–30 (East-West Frwy.) in downtown Fort Worth.

Five fountain "sculptures," in which enormous amounts of water cascade to depths 16 to 38 ft. below street level, make up this unique urban installation. Covering 4.3 acres and completed in 1974 at a cost of $7 million, the "Gardens" were a gift of the Amon G. Carter Foundation. Five hundred coastal live oak, sweet gum, bald cypress, pistachio and white wisteria trees, plus a grove of ginkgos, accent the concrete, earth and water of the design, and ground covers contribute texture and color. The award-winning Gardens were conceived by architect Philip Johnson and John Burgee.

San Antonio Botanical Center

555 Funston Pl. **(512) 821-5115**
San Antonio, TX 78209

Hours: Tues.–Sun. 9–6; closed Dec. 25.
Admission: fee charged.
Directions: located in San Antonio, two blocks off Broadway on Funston Pl., between Brackenbridge Park and Ft. Sam Houston.
Public Transportation: via Transit to Broadway (two blocks to Funston).

The San Antonio Botanical Center opened to the public in 1980. The 33-acre site displays about 4,500 kinds of plants. A series of formal gardens includes the Old-Fashioned Garden (annuals and perennials), Herb Garden, with herbs used by Texas settlers, Biblical Garden and Rose Garden. Other points of interest are the Garden for the Blind and the Gazebo-Observatory, offering a panorama of the plantings.

Representations of three of Texas' unique ecological sectors, including plants and historic structures, are featured attractions at the Center. The East Texas Area, encompassing the Nacogdoches-Lufkin region, contains 1,300 native plants and three log buildings characteristic of the late 1800s. Two adobe structures and 900 different plants (cacti, yucca, live oaks) suggest Southwest Texas. The Hill Country/Edwards Plateau Native Area is a rolling meadow planted with 1,100 kinds of wildflowers, trees and shrubs.

Utah

State Arboretum of Utah

University of Utah **(801) 581-5322**
Building 436
Salt Lake City, UT 84112

Hours: campus grounds, every day all hours; Arboretum Office, Mon.–Fri. 8–5; Conservatory, by appointment only; Red Butte Development Site, Apr.–Oct., Mon.–Fri. 8–5.
Admission: no fee.
Directions: located on the University of Utah campus, 3 mi. from downtown Salt

State Arboretum of Utah, Salt Lake City, Utah

Lake City; at the intersection of 100 South and 1400 East.
Public Transportation: accessible from downtown Salt Lake City by Utah Transit Authority buses #4, #24 and #11.

The 1,500-acre campus of the University of Utah forms a major portion of the State Arboretum of Utah, established in 1961. On land gradually reclaimed from the Utah sagebrush steppe since 1930, the Arboretum is now forested with over 8,000 trees of 300 species and varieties. Over 400 exotic taxa are represented in the Conservatory (1,100 sq. ft.). The Red Butte Development Site, encompassing an additional 147 acres, harbors more than 300 large conifers and an extensive collection (over 75 taxa) of dwarf kinds.

Specialized areas on the University grounds include the Cottam Hybrid Oak Grove, the conifer collection (over 40 taxa) and the Faculty Women's Club Rose Garden. The Arboretum boasts the largest Russian Olive (*Elaegnus angustifolia*) in the United States.

Vermont

Shelburne Museum and Heritage Park

Shelburne, VT 05482 **(802) 985-3344**

Hours: mid-May through late Oct., every day 9–5; Sun. in winter, 11–4.
Admission: fee charged.
Directions: located 7 mi. south of Burlington, on U.S. 7.
Public Transportation: accessible from Burlington by bus.

The 45-acre Shelburne Museum features over 35 historic exhibit buildings in a parklike setting. Specialty plantings include the Herb, Rock and Rose Gardens. The collection of Americana displayed indoors ranges from waterfowl decoys to circus figurines. The Museum was founded in 1947 by Electra Havemeyer Webb to "show the craftsmanship of our forefathers."

Virginia

American Horticultural Society: River Farm

Location:	**Mailing Address:**
7931 East Boulevard Dr.	**P.O. Box 0105**
Alexandria, VA	**Mount Vernon, VA**
22308	**2212**

Hours: Mon.–Fri. 8:30–5
Admission: no fee.
Directions: located 4 mi. south of Alexandria, on George Washington Pkwy.; left at "East Boulevard Dr., Herbert Springs Arcturus" sign, and follow signs.

River Farm, one of the five farms that once formed George Washington's Mount Vernon estate, is the home of the American Horticultural Society (AHS). The 25 acres of gently rolling hills, river frontage, lawns and large shade trees (admired by Washington) now provide Society members and visitors with various test and display gardens.

Plantings of boxwood, magnolias, wisteria and other ornamentals set off the main house. In addition to its historical attractions, River Farm features modern plants in its idea garden and in its All-America Selections (roses, annuals, vegetables) gardens. Daylilies, lilies, marigolds, iris, chrysanthemums, cacti and succulents are also featured, and the site is an official test facility for dahlias. Additional specialized areas include a demonstration orchard, children's garden, herb garden, meadow and water garden.

Woodlawn Plantation

Location:	**(703) 557-7880**
900 Richmond Hwy	**(703) 557-7881**
Alexandria, VA	**Mailing Address:**
	P.O. Box 37
	Mount Vernon, VA 22121

Hours: every day 9:30–4:30; closed Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: fee charged.
Directions: located 14 mi. south of Washington, D.C., on U.S. 1; 3 mi. west

of Mount Vernon.
Public Transportation: accessible by Washington Metro Bus.

Blandy Experimental Farm and Orland E. White Research Arboretum

University of Virginia **(703) 837-1758**
P.O. Box 175
Boyce, VA 22620

Hours: every day, sunrise–sunset.
Admission: no fee.
Directions: located 1.5 mi. east of the junctions of Rts. 17, 50 and 340, 4 mi. west of the Shenandoah River Bridge across Rts. 17 and 50; entrance is on Rts. 17 and 50.

The Blandy Experimental Farm is the result of a gift of 700 acres from Graham F. Blandy to the University of Virginia in 1926. Under the Farm's first director, Dr. Orland White, a number of trees and shrubs were brought to it for observation and research, and a 100-acre Arboretum was the eventual outcome. Today, more than 1,000 kinds of plants grow at the research facility.

The Orland E. White Arboretum specializes in boxwood (headquarters of the American Boxwood Society) and conifers, and features an extensive planting of ginkgos and an herb garden. Other specialties include magnolias, maples, oak, roses and olives.

Ash Lawn

Rt. 6, P.O. Box 37 **(804) 293-9539**
Charlottesville, VA 22901

Hours: Mar.–Oct., every day 9–6; Nov.–Feb., 10–5; closes Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: fee charged.
Directions: located 5 mi. southeast of Charlottesville's city limits, 2½ mi. past Monticello.

Ash Lawn, a historic house/museum, was the home of James Monroe, the fifth President of the United States. The 535-acre site is owned and operated by the College of William and Mary, and 20 acres are open to the public. Plants popular during Monroe's lifetime are featured in the vicinity of the house and

Mount Vernon Ladies Association, Mount Vernon, Virginia

hroughout the landscape. A vegetable garden nd an herb garden are other highlights.

Monticello

P.O. Box 316 (804) 295-8181
Charlottesville, VA 22902 (804) 295-2657

Hours: Mar.–Oct., every day 8–5; Nov.–Feb., 9–4:30; closed Dec. 25.
Admission: fee charged.
Directions: located 1.5 mi. southeast of Charlottesville, on Rt. 53.

At Monticello, Thomas Jefferson's personality is reflected in the house he designed and in the gardens and grounds he developed so carefully for more than 40 years. About the property, he laid out terraces, lawns, a "roundabout" walk bordered by flower beds, an extensive (1,000 ft.–long) vegetable garden, orchards and vineyards, in addition to the numerous outbuildings necessary for the functioning of a farm. Through archaeological investigation and referral to Jefferson's Garden Book, much of the site has been restored according to his plan. Today, Monticello's plantings feature over 150 cultivated species of pre-1826 annuals and perennials, vegetables grown in the 19th century and species native to Virginia.

Mount Vernon

Mount Vernon Ladies' Association
Mount Vernon, VA 22121
(703) 780-2000

Hours: Apr.–Oct., every day 9–5; Nov.–Mar., 9–4.
Admission: fee charged, except on George Washington's Birthday.
Directions: located at the southern terminus of Mount Vernon Memorial Hwy., 8 mi. south of Alexandria and 16 mi. from downtown Washington, D.C.
Public Transportation: accessible by tour bus and boat cruises from Washington.

Mount Vernon, the former home of George Washington, is owned and operated by the Mount Vernon Ladies' Association, founded in 1853. About 30 of the estate's 500 acres are open to the public, and these are presented as they might have appeared in 1799, the year of Washington's death.

Some of the mature trees bordering the bowling green at the entrance to the property date from the original planting. On opposite sides of this large expanse of lawn are the wall-enclosed Kitchen Garden and the Flower Garden. The boxwood-edged beds of the latter are planted with flowers that were familiar to 18th-century Virginians. Between the Flower Garden and mid-Georgian manor house is the Botanical Garden, where Washington experimented with various plant materials.

Norfolk Botanical Gardens

Norfolk VA 23518 **(804) 853-6972**

Hours: Gardens, every day 8:30–sunset; administration buildings, Mon.–Fri. 8:30–5, weekends and holidays 10–5.
Admission: fee charged, except Christmas week.
Directions: from Norfolk, follow signs for the International Airport; located north of the Airport, bordered by Rt. 170.

The Norfolk Botanical Gardens cover 175 acres and feature extensive azalea and camellia plantings. Over 12 miles of pathways lead visitors through a setting of native plants, 250,000 azaleas and over 700 varieties of camellias. Containing 4,500 kinds of plants in all, the Gardens are just inland from Chesapeake Bay and are operated by the City of Norfolk's Department of Parks and Recreation.

Features include: the New Rose Garden, with over 4,000 roses of 250 varieties, fountains, terraces and sculpture; the Japanese Garden; Sanctuary Vista, graced with 11 Victorian-style statues; the Fragrance Garden; Holly Garden; Lone Pine Garden; Colonial Garden; Fig-

ure Eight Garden; Ferndale Enchanted Forest; Conifers; Desert Garden; Renaissance Garden; Flowering Arboretum, with over 400 trees; Perennial Vista; and a 2,550 sq.-ft. greenhouse, displaying orchids year-round. Containing an All-America test garden for annuals and roses, the Gardens grow over 40,000 annuals each year. Visitors may view the entire Gardens from the Observation Tower.

Norfolk Botanical Gardens were established in 1938 as a WPA (Work Projects Administration) undertaking.

Maymont

1700 Hampton St. **(804) 358-7166**
Richmond, VA 23220

Hours: grounds, Apr.–Oct., every day 10–7, Nov.–Mar. 10–5; indoor exhibits, Apr.–Oct., Tues.–Sun. 12–5, Nov.–Mar., 12–4, closed Thanksgiving Day, Dec. 25 and Jan. 1.
Admission: no fee.
Directions: I–95 to Exit 14 south; travel 2 mi., then follow Maymont signs to Hampton St. entrance.

Maymont, a 105-acre estate operated as a family park by the Maymont Foundation, was once the home of Major and Mrs. James Henry Dooley. It was bequeathed to the City of Richmond in 1925, and declared a National Historic Landmark in 1971. Five hundred kinds of plants are incorporated into the landscape and gardens.

The house is a neo-Romanesque residence, typical of the Gilded Age. Horticultural attractions include a formal Italian Garden, Japanese Garden, Arboretum, Herb Garden and Wildflower Garden. The Renaissance-style Italian Garden features fountains, a water cascade, pergola and elaborate stonework. A 75-ft. waterfall, streams, arched bridges, stones and appropriate plants are combined in the four-acre Japanese Garden. The trees in the Arboretum and on the grounds total 1,000, and many of them have been designated State Champions.

Colonial Williamsburg

P.O. Box Drawer C **(804) 229-1000**
Williamsburg, VA 23187

Hours: Mar.–Nov., plus the last two weeks in Dec. (including Dec. 25), every day 9–5; walking tours of the gardens, Mon.–Fri. 10:30–2:30.
Admission: fee charged.
Directions: I–64E from Richmond (1 hour); I–64W from Norfolk (45 minutes); historic buildings and gardens line Duke of Gloucester St.

Numerous gardens surround the re-created and restored buildings that comprise historic Colonial Williamsburg. The designs of the gardens are based on several sources: maps of the old town, remnants of Virginia's colonial plantations and British gardens that date from the time of King William III, for whom Williamsburg was named. Today, nearly 100 acres of the restoration are either gardens or "greens."

The most extensive garden graces the Governor's Palace; it features English, French and Dutch styles of landscape design. In addition to touring the Palace grounds, visitors may spend a day discovering the many smaller more intimate gardens, featuring topiary herbs, vegetables and native and exotic ornamentals.

Restoration of Colonial Williamsburg as an "outdoor museum" began in 1926, with the support of Mr. and Mrs. John D. Rockefeller

Washington

Bloedel Reserve

7571 N.E. Dolphin Dr. **(206) 842-763**
Brainbridge Island, WA 98110

Hours: for groups (10 to 50 people) only, b appointment.
Admission: no fee.
Directions: phone for directions and appointment.

Seymour Conservatory, Tacoma, Washington

Rhododendron Species Foundation

P.O. Box 3798 **(206) 927-6960**
Federal Way, WA 98063-3798 **838-4646**

Hours: mid–Mar. to May, Wed. 10–3, Sun. 1–5; for Fall Foliage Festival, mid-Oct., 10–5 (call for exact dates, which change yearly); year-round, Mon.–Fri. 10–3, by appointment.
Admission: fee charged.
Directions: located 24 mi. south of Seattle on I–5; Hwy. 18 to Exit 142A east; left (north) at 32nd Ave. South; continue to the entrance of Weyerhaeuser Corporate Headquarters; located on the southwest corner of the Weyerhaeuser campus.

The Rhododendron Species Foundation (RSF) was formed in 1964, and the present 24-acre display garden began development in 1974. The Weyerhaeuser Company offered the land on a long-term lease, and provided partial funding. Over 10,000 rhododendrons representing more than 500 species have been collected by the RSF. The garden constitutes one of the "most diverse and complete collections of species rhododendrons in the world."

Rhododendrons from all parts of the globe are represented at RSF. In the Study Garden, selected plants are grouped to indicate their botanical relationships. Specialized habitats include a meadow, pond area and alpine area.

Carl S. English, Jr., Gardens

Army Corps of Engineers **(206) 783-7059**
3015 NW 54th St.
Seattle, WA 98107

Hours: gardens, every day 8–9; Visitor Center, summer, every day 11–9, winter, Thurs.–Mon. 11–5.
Admission: no fee.
Directions: I–5 to NE 45th St. exit west; travel about 6 mi.
Public Transportation: Metropolitan Bus Authority, Rts. 43 and 17.

The Carl S. English, Jr., Gardens contain about 800 species of native and exotic plants, with trees and shrubs emphasized. Special collections include rhododendrons, pines, oaks and magnolias.

The Gardens, located at Chittenden navigational locks, were developed by Carl S. English, Jr., who, from 1933 to 1974, gathered plants from all over the world.

Washington Park Arboretum

University of Washington **(206) 543-8800**
(XD-10)
Seattle, WA 98195

Hours: every day 8–sunset; Japanese Garden, Mar.–Nov. only.

Admission: Arboretum, no fee; Japanese Garden, fee charged.
Directions: located between Montlake Blvd. and E. Madison on Lake Washington Blvd. East; from I–5, take Exit 168 (Bellevue-Kirkland), then take the first exit (Montlake-University of Washington); at the light, cross Montlake Blvd. to Lake Washington Blvd.; at stop sign, turn left onto Foster Island Rd., and follow signs to the office.
Public Transportation: accessible by Metro bus #11, 43, 48 from all parts of the city.

The Washington Park Arboretum, affiliated with the Center for Urban Horticulture of the University of Washington, displays about 5,500 species of woody plants on 200 acres. At the northern end of the site is Foster's Island, where alders, birches, pines and oaks are planted in a natural setting. Other highlights include: the Winter Garden; the Woodland Garden, with two ponds and a creek surrounded by a collection of Japanese maples (planted in 1940); Loderi Valley, a wooded area planted with magnolias and hybrids of *Rhododendron loderi;* Rhododendron Glen; and Azalea Way, the Arboretum's major trail, lined with flowering cherries, azaleas and dogwoods. At the southern end of the site is the Japanese Garden, displaying Oriental-style plantings in a pond setting. Other plant groups to be found on the grounds include conifers, Legume Family members, mountain ashes, camellias, cistus and lindens.

Originally Washington Park, Washington Park Arboretum began devoting itself to the preservation and display of trees and shrubs in 1924.

Woodland Park Zoological Gardens

5500 Phinney Ave. North **(206) 782-1265**
Seattle, WA 98103

Hours: winter months, every day 8:30–4; summer months, 8:30–6.
Admission: fee charged.
Directions: located 2 mi. west of I–5 on North 50th St.; 6 mi. north of downtown Seattle; near Green Lake, just off U.S. 99 (Aurora Ave.).
Public Transportation: accessible by Bus #5 from downtown Seattle.

The Woodland Park Zoological Gardens provide simulated native habitats for some 400 species of animals. Woodland Park, originally a private estate developed in the late 1800s, was laid out in traditional English-park style. A formal rose garden, with All-America Selections and topiaries, and about 3,000 stately old trees remain from the early years.

Seymour Conservatory

Wright Park **(206) 591-533**
South I and G Sts.
Tacoma, WA 98407

Hours: every day 8–4:20
Admission: no fee.
Directions: I–5 into Tacoma to City Center off ramp; right at Pacific Ave.; left at City Hall; first right, then first left onto 3rd St four blocks to Wright Park.
Public Transportation: accessible by Metro Bus.

Seymour Conservatory is located in Tacoma's one-acre Wright Park. The Victorian structure—built in 1908, fully restored in 1975-76 and designated a Historic Landmark—shelters palms, ferns and other tropicals under its glass dome.

Ohme Gardens

3327 Ohme Rd. **(509) 662-575**
Wenatchee, WA 98801

Hours: Apr. 15 to Oct. 15, every day 9–dusk.
Admission: fee charged.
Directions: located 3 mi. north of Wenatchee, near the junction of Hwys. 2 and 97.

Woodland Park Zoological Gardens' Rose Garden, Seattle, Washington

At Ohme Gardens, more than a thousand trees, planted amid craggy rock outcroppings and softened by carpets of alpine plants and placid mountain pools, have turned nine barren hilltop acres into a green oasis. In all, some 50 kinds of plants may be found in the Gardens. Paths of native stone lead visitors up the hillside, past waterfalls, fern-bordered pools and rustic shelters. The elevated site offers a spectacular vista that includes Wenatchee Valley, the Columbia River and the Cascade Mountains.

For the purpose of creating a private retreat for their family, Herman Ohme and his wife began gardening on the hill in 1929. The Gardens opened to the public in 1939, and today Gordon Ohme continues to build on the efforts of his parents.

P

Wisconsin

Boerner Botanical Gardens in Whitnall Park

5879 South 92nd St. **(414) 425-1130**
Hales Corners, **529-1870**
WI 53130 **(for tour reservations)**

Hours: mid–Apr. to Oct., every day 8–sunset; Nov. to mid–Apr., Mon.–Fri. 8–4.
Directions: located in the southwest section of Milwaukee County; Whitnall Park is about 2 mi. south of the intersection of I–894 and Hwy. 15, south of Grange Ave. and north of Rawson Ave.
Public Transportation: accessible by city bus (stop is about 3/4 mi. from the Gardens).

The Boerner Botanical Gardens, a major unit of the Milwaukee County Park System, display over 10,000 kinds of plants in the north-central section of the 660-acre Whitnall Park. Boerner's specialty gardens include the Herb Garden, Rose Garden (3,000 plants), Rock and Wildflower Garden, Bog Garden, Annual and Perennial Display Gardens, Peony Garden and Shrub Mall. Nature trails meander past woody plant collections, including dwarf shrubs, hedges, street trees, conifers, lilacs and shrub roses, as well as one of the finest and largest crabapple collections in the United States.

Land for the Park was acquired around 1930, and the Botanical Gardens were developed during that decade.

The University of Wisconsin Arboretum - Madison

1207 Seminole Hwy. **(608) 263-7888**
Madison, WI 53711

Hours: grounds, every day 7 a.m. to 10 p.m.; MacKay Center, weekdays 9–4, weekends 12:30–4; closed holidays.
Admission: no fee.
Directions: located off Seminole Hwy., ¼ mi. north of its intersection with Hwys. 12, 14, 18 and 151; on the south edge of Madison.

The University of Wisconsin Arboretum is a complex of reconstructed plant and animal habitats, as well as horticultural collection areas. On the 1,270-acre site (600 acres open to the public), ecological microcosms and horticultural displays are connected by more than 20 miles of trails and fire lanes. Prairies, deciduous forests, conifer forests and wetlands form the various habitats, which include: Curtis Prairie (60 acres), the world's oldest restored tall-grass prairie; Greene Prairie (45 acres); and Noe Woods, a deciduous oak forest on 43 acres. The conifer forests include the Aldo Leopold Pines (59 acres) and Boreal Forest Plantings (14 acres).

Adhering to the more traditional concept of an Arboretum are the Longenecker Horticultural Gardens—50 acres, with collections arranged by genus and specialized groupings. Notable among these are the lilacs (230 species and varieties), flowering crabapples (135

Boerner Botanical Gardens in Whitnall Park, Milwaukee Park Commission, Education and Information Office, Hales Corner, Wisconsin (photo: Felton)

kinds), a small, formal shrub garden and the Pinetum, focusing on pines, spruces, firs and junipers. The Viburnum Garden, located on Manitou Way, contains more than 80 species and varieties of viburnums.

Development of the University of Wisconsin Arboretum began in the 1930s.

Mitchell Park Horticultural Conservatory

524 S. Layton Blvd. **(414) 278-4383**
Milwaukee, WI 53215

Hours: Memorial Day to Labor Day, Mon.–Thurs. and weekends 9–8, Fri. 9–5; winter, Mon.–Fri. 9–5, weekends 9–8.
Admission: fee charged.
Directions: located at S. Layton Blvd. and W. Pierce St.
Public Transportation: accessible by city bus.

Three contemporary, 85 ft.-high glass domes form the Mitchell Park Conservatory, the star attraction of the 63-acre Park. Covering 2½ acres, the Conservatory shelters more than 3,200 kinds of plants. The tropical-garden house emphasizes colorful and economically important tropicals. The Arid Dome features over 1,000 species of desert plants. Displays in the third dome change five times a year to accommodate seasonal flowers. Just outside the Conservatory, the Sunken Gardens, containing waterlilies and other aquatic plants, is a featured summer attraction.

The original Mitchell Park Conservatory, built in the 1890s by the City Department of Parks, was razed in 1955, and the present Conservatory was erected from 1959 to 1964.

Paine Art Center and Arboretum

1410 Algoma Blvd. **(414) 235-4530**
Oshkosh, WI 54901

Hours: Tues.–Sat. 10–4:30, Sun. 1–4:30; closed national holidays.
Admission: donation requested.
Directions: located in Oshkosh, 80 mi. north of Milwaukee; Hwy. 41 to Hwy. 110 (Algoma Blvd.); at the junction of Hwys. 110 and 21.

Fifteen acres surrounding the Paine Art Center comprise an arboretum that displays native and exotic trees, shrubs and herbaceous plants. The four acres immediately encircling the Center's manor house are patterned after 18th-century English gardens. In addition to the flower borders found here, an herb garden and rose garden are offered. Inside the Tudor-style mansion, visitors may examine the collection of paintings, as well as period furnishings. Across Algoma Boulevard, the Arboretum continues with a crabapple display, woodland and prairie.

Built in the 1920s, the estate was planned as the residence of Mr. and Mrs. Paine, but Mr. Paine died before it was completed. The Paine Art Center and Arboretum opened to the public in 1948.

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Kitchen Herbs

Elms of Yesterday
and Today

The Urgency of
Tropical Conservation

Restoring
Bartram's Garden

Book
Reviews

And More. . .

Vol. 42 No. 4 1986-87

PLANTS & GARDENS

BROOKLYN BOTANIC GARDEN RECORD

The Year's Highlights

In Gardening and Horticulture

1986/87

Brooklyn Botanic Garden

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BROOKLYN BOTANIC GARDEN RECORD

The Year's Highlights

In Gardening and Horticulture:

Vol. 42 1986-87 No. 4

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RESTORING BARTRAM'S GARDEN

America's Oldest Surviving Botanical Garden

Rudy J. Favretti

When King George III made John Bartram "His Majesty's Botanist for North America" in 1765, he bestowed this honor, title, and an annual stipend of 50 pounds sterling upon the first American-born botanist of merit. Self taught, with only a fourth grade education, Bartram's interests encompassed the entire field of natural history: ecology, entomology, ethnology, geology, medicine, meteorology, ornithology, zoology, and paleontology. As a boy on a farm, he studied the minerals in the soil he plowed, observed plants along the waysides, noticed birds, fish, and other animals in their natural habitats, and generally developed a keen awareness of the complex web of nature.

It was as botanist, however, that Bartram was best known. In 1728, he established a botanical garden, considered to be one of the first in the Colonies, in Kingsessing, near Grays Ferry, now part of greater Philadelphia (54th Street and Lindbergh Boulevard).

After he purchased his own farm he began to collect plants from all over the colonies, and to grow them on for study and export or exchange purposes. His garden in Philadelphia was ideally located between the harsh climate of the North and the milder one of the South, a prime location for a botanical garden.

He was a progressive and prosperous farmer, who was assisted by his wife and nine children in his enterprise. The best time for John to get away to collect was in the autumn when the crops were in and there was a lull in the list of chores that usually confronted him. Autumn was also an ideal time to collect seeds and plants.

Bartram made many expeditions. First he collected near home. Then he went further afield, as far as the Ohio River. Eventually he made trips to Virginia, the Carolinas, Georgia, and to the North as far as Lake Ontario. These trips were exceedingly dangerous because there were few roads to follow, just trails broken by native Indians whom he frequently encountered. His botanizing was also expensive, so the stipend he received from King George III helped pay for his most famous trip to Florida and Georgia. As his son William grew older he became his father's companion on many of these trips.

The list of people with whom John Bartram corresponded, or who visited his garden, or who received his plants or seeds, reads like a "Who's Who" in botany and natural history. Locally, there was James Logan, William Penn's secretary, who offered encouragement and loaned him books, and Benjamin Franklin, to name just two. Dr. John Mitchell, Rev. Jared Eliot (author of *Essays on Field Husbandry*), John Clayton, Cadwallader Colden, Peter Kalm, and Dr. Alexander Garden corresponded with Bartram. In Europe his corres-

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Rudy J. Favretti, landscape architect, was the master planner for Bartram's Garden. He is professor of Landscape Architecture of the University of Connecticut, Storrs. He has worked on many other historical sites.

Reprinted with permission from the Pennsylvania Horticultural Society, The Green Scene, *September 1986.*

Bartram's house was built in the late seventeenth century and added on to by John Bartram and his granddaughter in the eighteenth and nineteenth centuries.

pondents were Carl Linnaeus, Professor Dillenius of Oxford, Dr. J.K. Gronovius of Leyden, Holland, Sir Hans Sloane and Dr. John Fothergill, Philip Miller, author of the *Gardener's Dictionary,* and Peter Collinson, merchant, perhaps his best friend and most active correspondent. All of these men, like Bartram, had occupations other than botany. Yet the fact that most of them had plants named after them—*Franklinia, Mitchella, Gardenia, Claytonia, Collinsonia, Fothergilla, Kalmia,* etc.—attests to the reputations they gained in their avocation. Bartram, too, was so honored with *Bartramia.*

John Bartram received many honors, among them a medal from the Society of Gentlemen of Edinburgh, election to the Royal Academy of Stockholm, and also to the Royal Society of London, all very high honors for a simple-living and self-taught Quaker farmer. Linnaeus considered him the most brilliant botanist of his day.

John Bartram lived a long and productive life from 1699 to 1777. When he died he willed the botanical garden to his son John. He was very fond of William, but had little faith in his ability to manage money and property. William, however, came home from the South to help run the garden, which he did until his death in 1823. While doing so he wrote his *Travels Through North and South Carolina, Georgia, East and West Florida* (1791), for which he became famous. He was talented as a painter of nature, especially birds. In 1782, William was offered a professorship of botany at the University of Pennsylvania, which he refused. Washington, Jefferson and Peale were among his friends and often visited the Garden.

When John Bartram, the son, died in 1812, the Garden was inherited by his daughter, Ann Carr, wife of Colonel Robert Carr, and they ran it until 1850 when it was sold to Andrew Eastwick who respected it and would not build his mansion within the bounds of the original botanical garden. In 1891, after Eastwick's death, Thomas Meehan, who had been his gardener and who had become a well known nurseryman and a member of the City Council of Philadelphia, convinced the City to acquire the garden and make it part of the city park system.

The Restoration Plan

Today we are fortunate that these events came to pass, and that in 1893 The John Bartram Association was formed to oversee the garden areas as well as the excellent stone house and buildings built by John Bartram and his offspring. In 1981, The John Bartram Association and its Long Range Planning Committee began the study and planning that culminated in a master plan for the restoration of Bartram's Garden. This plan was completed and approved in May, 1984.

What is involved in the restoration of a

major site like Bartram's Garden? The first step is to learn what is available through plans, the printed word, letters, diaries and similar documents, and graphic materials. This information was researched and gathered together by the Bartram Association staff, largely through the efforts of Carol Rowland Palmer. A major task, it was completed before the master planning process began. This "Research Report on Bartram's Garden" contained not only abstracts and reprints of valuable documents, but also a plan drawn to scale of all existing features on the site and especially the existing plant collection, including the famous *Franklinia* and the ancient and majestic yellowwood *(Cladrastis lutea).*

As a next planning step, the data found through research was tested against the actual site. One of the most valuable documents for this purpose was a plan of Bartram's Garden, drawn in 1758 by John Bartram himself and sent to his friend Peter Collinson. (A copy of the plan accompanies this article; the original plan is in the library of the Earl of Derby, Knowsley, England). It shows the house at the very top of the garden with three garden plots in front, each plot separated from the other by a path. The plot to the left (south) was the new flower garden where Bartram planted all of the new and exotic material sent to him by others or collected by him. The central plot he called the common flower garden, which we have interpreted to mean the garden from which cuttings and seeds were collected to disseminate around the world. The northernmost plot was the upper kitchen garden for small vegetables that were needed near the house to feed his large family.

Below this upper terrace were two long walks descending to the Schuylkill River; sheltering and bordering these walks were trees and shrubs that were probably underplanted with herbaceous material. Many visitors have written about strolls along these walks, enjoying the shade while studying plants. One such guest, the Rev. Mannasch Cutler, a well known clergyman and naturalist, wrote in 1787: ". . . from the house is a walk to the river, between two rows of large, lofty trees, all of different kinds, at the bottom of which is a summer house on the bank, which is here a ledge of rock and is so situated as to be convenient for fishing in the river. . ." In surveying the site against this traveler's account what appears to be the foundation of this summer house was found under a tangle of weeds and brambles.

To the north of these two allées were two more kitchen gardens, each one apparently bordered with shrubs. It is believed that in later years, when sons John and William were in charge, much of this vegetable garden area was converted to nursery plants. Between these two kitchen garden beds was another path with a pond for growing aquatics, fed by a channel from a springhouse, situated on the very northern edge of the garden. In probing the actual site it was discovered that where the springhouse once stood, a large mound of earth now stands, and we believe that beneath it may be remnants of its springhouse foundation. Also, where the pond once stood there is a saucer-shaped depression in the earth; the soil from this depression tested high in aluminum, indicating a pond was once there.

The restoration plan projects the reconstruction of all of the paths in their proper places, the recreation of all of the garden plots as they were, the reconstruction of the springhouse, water channel and pond, and planting trees, shrubs and perennials along the allées and bordering the kitchen gardens. The gardens on the upper terrace will also be restored, but the two large, lower kitchen gardens will not be planted. These areas will be left in grass and natural groundcovers. Plants selected for this restoration were selected from Bartram's extensive lists; all existing trees and shrubs on the site, save for a few in poor condition, will be preserved.

The plan that John Bartram drew might be considered the most important research document for master planning. The Garden, however, was much larger than these few acres enclosed by a paling fence. There were outbuildings, including greenhouses and nursery beds to the north, as well as a large ramp ascending from the river so that hay and other materials might be carried to the barn. There was also a landing at the river where one could approach the garden by boat. The master plan calls for installing such a landing, and we hope that boats may once again carry visitors to the garden via this route. There

were also trees and an orchard to the south of the garden shown on the 1758 plan. The gardens on the west side of the house were part of the approach by land.

John Bartram laid out his garden in a manner used since ancient times: long walks, bordered gardens, laid out in squares and rectangles but in no way formal. It had a land front as well as a water front, just like so many other gardens in Philadelphia. His garden was different, however, in that the long walk was not in the center with gardens mirroring one another on either side. Unique, however, were the many habitats and exposures that existed within such a small site. While the garden descended to the east all the way down to the River, within this descent were little nooks and crannies that faced west, north, and south made possible by uneven terrain. Marshland fronted the river; he created the pond in the center of the garden, and used the drier soil at the top of the hill to drain excess water away. The site was perfect for a botanical garden.

Modern Urban Problems

Finding the authentic garden layout and recreating it is not the whole master planning process, however. With attendance at Bartram's garden growing steadily, (now over 8,000 per year) problems such as where to park cars and buses, providing rest facilities, making a space for lectures, orientation, and classes, providing museum space to show the multi-faceted activities of the Bartrams, John and William, and finding office space for the staff, now located in the upper stories of the house are additional challenges. Moving visitors through the site in an orderly and safe manner, without jeopardizing the authenticity of the site is also a major consideration.

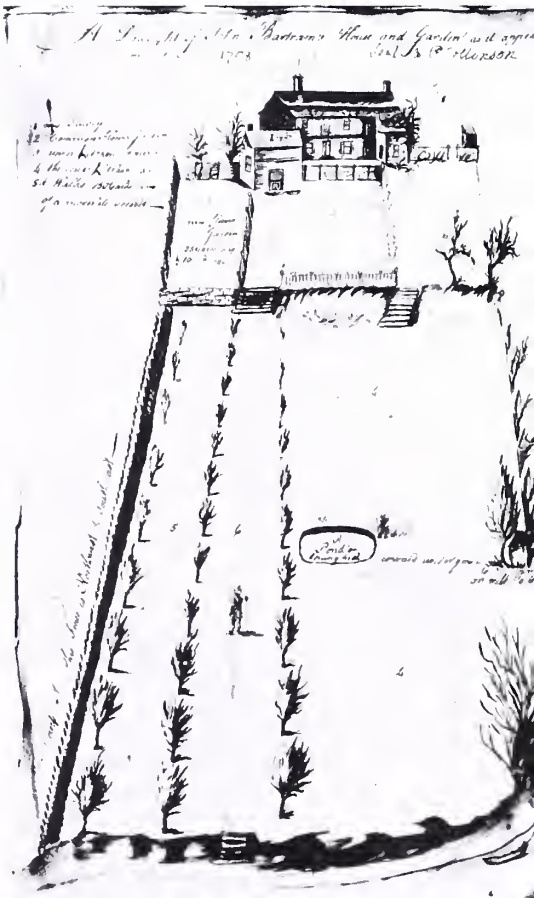
The accompanying sketch shows where all of these functions were fitted into the existing buildings on the site, all part of the original Bartram plan, with the exception of a new office building. The old stone barn will become a farm museum to show that aspect of the Bartrams' life. The basement of this building will be equipped with rest facilities. The old carriage house will be a museum shop so that the present one may be removed from the conservatory attached to the south side of the house. An auditorium will be housed in the stable for teaching, and the barnyard that forms an enclosed space between these buildings will become a resting and demonstration area for visitors.

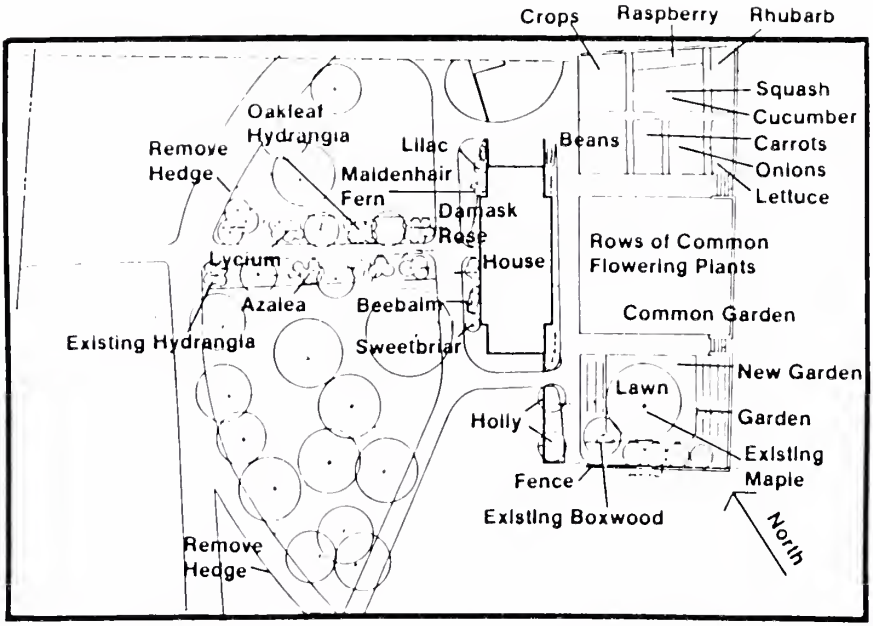
Two other outbuildings, Bartram's seed house, and the ice pit and root cellar will be restored to their original use. The seed house, a small, tight stone structure is thought to be where Bartram received and prepared his seed and plant shipments for abroad.

In addition to creating a new parking area, the master plan called for the upgrading of the main entrance off Lindbergh Boulevard, with new fencing, plantings, and an attractive entrance sign, which was accomplished last year. The large tract of land to the north of the Garden, approximately 17 acres and

A drawing of John Bartram's House and Garden in 1758.

Courtesy of the John Bartram Association and the Earl of Derby, Knowsley, England





Bartram's Garden . . . Planting Plan

recently acquired by the city, will be restored and seeded as it probably was during John Bartram's time, and will act as a buffer to the Garden. The open land to the south of the garden, the location of the Eastwick mansion, will be historically identified and continue to be used for passive recreation.

The master plan for Bartram's Garden is carefully worked out through stages. Some of the work has started, such as improving the entrance road, and architectural planning for the renovation of the outbuildings (the house has already been restored). Existing plants are being cared for. The Philadelphia Committee of the Garden Club of America has funded an internship, through which all of the hundreds of difficult to obtain plants needed for the restoration may be acquired and held in a nursery at the garden. The Association has begun a capital campaign drive to raise the one million dollars necessary for the first phase of the restoration.

As the less costly aspects of the master plan proceed, fund raising goes on to raise the millions necessary to complete the total project. Enthusiasm for restoring the Garden is high. Philadelphia, which had better facilities for the study of natural history than any other city during John Bartram's time, is fortunate that through the foresight of Bartram, Eastwick and his gardener Thomas Meehan, Philadelphia's Fairmount Park Commission and the John Bartram Family Association, it has the site of the original Garden, with all its buildings, still intact. Many cities have lost important sites to "progress." While the restoration project seems large and costly, it is the least that can be done to preserve America's oldest surviving botanical garden which is known throughout the world.

Visit Bartram's Garden
57th & Lindbergh Boulevard,
Philadelphia, PA 19143

You may call for directions and other information. Phone: (215) 729-5281

The Garden is open daily throughout the year (including holidays) from dawn to dusk. Free.

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Group tours for adults and children by appointment.

Winter injury

Wondering what plants you'll lose this year to winter injury? Learning how to detect winter injury and knowing how to protect your plants from it will help cut those losses.

Sharon J. Collman

The symptoms of winter injury depend on the plant species, condition and factors that caused the injury. In diagnosing any plant injury, there are two areas to examine—symptoms and signs.

A *symptom* is the plant's response to injury. Symptoms of cold injury can be reddening of the leaves, yellowing, browning or blackening (necrosis), dropping, curling, crisping, twisting, rolling downward, turning from glassy-green to black and slimy, shriveling, etc. The symptom is the "crime."

A *sign* is the actual presence of the causal agent, such as an insect, fungus fruiting bodies, honeydew, hail, etc. The signs are the "evidence."

Because cold damage is not caused by an insect or disease, there will be no signs to match the symptoms. That is not to say that injured leaves will not have insects or fungus signs. There may be lady beetles, aphids, caterpillars or secondary fungi present on the dead leaf tissue. Double check to make sure the symptoms and signs match. (For a complete list, see "Winter injury damage symptoms.")

Low-temperature injury is usually manifested by several symptoms. First, extreme cold will cause the leaves, twigs, stems and even roots (which do not have basic genetic hardiness to low temperatures) to freeze. Essentially, this type of cold causes a disruption and breaking down of the cell contents and tissues. This damage can also occur to normally hardy plants in which the tissues have not hardened off for one reason or another. Symptoms of this kind of injury are severe wilting, complete blackening or browning of the leaves and stems, and general collapse of above-ground plant parts. Occasionally, only the flower buds of certain plants (like some rhododendrons) are killed. Freezing temperature in spring after the buds have begun to swell will often result in abnormally twisted and curled new leaves.

Raphiolepsis displaying evidence of freeze damage

Very low temperatures are often accompanied by bright, sunny days. If these conditions continue for a period of time, the ground will freeze solidly. This prevents the roots from bringing up sufficient moisture to replace that transpired through the leaves and stems. Symptoms of this damage are often characterized by the browning or "burning" of leaf margins, entire leaves and stems. If this condition continues long enough, it can result in dieback of portions of plants or even their death.

Sharon J. Collman, Washington State University Cooperative Extension in Snohomish County.

Reprinted with permission from Grounds Maintenance, *October 1986.*

Often, under conditions of bright, sunny days and very clear, cold nights, the stems and trunks of shrubs and trees will split longitudinally. These splits can be narrow or wide and are located on the south or west sides of the plants. When unfavorable conditions occur, frost cracks can even occur on plants considered to be hardy, such as Japanese maples, flowering cherries and fruit trees.

Shrubs and trees that are growing in containers above ground level are susceptible to root damage. Plant roots are less hardy than the tops and normally hardy species can be destroyed if the containers in which they grow are subjected on all sides to low temperatures. This kind of damage is often not noticed until spring, when little or no new growth takes place.

Some gardeners are accustomed to leaving the roots (corms and tubers) of gladiolus and dahlias in the ground during the winter. These survive most winters. However, if the frost accompanying low temperatures penetrates the ground to their level, they may be killed. This will be evident in spring when no new growth emerges. Heavy mulching with organic materials can help keep frost from reaching their level. Mulches can also afford protection to other less hardy perennial plants that may be damaged by cold or heaved above ground by frost.

Escallonia: sun/freeze damage

Other types of damage

Some winter injury is actually drought injury. On sunny days with drying winds, water is lost from the leaf surface. Because the soil is frozen, the plant cannot replace the lost water.

Landscape plants gain hardiness by a process called acclimatization or hardening in the autumn. This is due to some environmental signal like gradually cooling temperatures and/or decreasing day length. Maximum hardiness is achieved in mid-winter and the plant gradually loses hardiness from mid-winter to spring. An unusual cold snap in the fall, before the plant is fully hardy, may injure plant tissue, as will a late spring freeze after the plant has deacclimatized.

One other point on the dehardening process is that it is generally considered to be a slow process, but it may occur rapidly under certain conditions. Bright sunshine can heat up dark plant parts, such as bark and leaves, to well above the ambient temperature. If this incident radiation is suddenly removed, as by clouds or at sunset, the elevated temperature will drop rapidly. If the ambient temperature is below freezing, the plant may not have the ability to reacclimatize itself to its former degree of hardiness, and death of the plant tissue results.

In general, the most damage will be:

- On tissue farthest away from the veins, such as leaf edges, leaf tips and tops of plants.
- On the side of the plant most exposed to sun or air flow.
- On the leaf tissue that is perpendicular to the sun; sometimes the outline of an overhanging leaf will leave a green "shadow" on the sun-burned leaf.

False alarms

The leaves of rhododendrons and other broadleaf evergreens will often droop and roll during periods of severe cold weather. This normal condition is the plants' way of exposing as little leaf surface as possible to the cold. If the leaves do not return to their normal condition after temperatures have moderated, then damage may have occurred. Also,

the leaves of some evergreen viburnums enter a state of "winter wilt" at the onset of cooler weather. They hang in this fashion until spring, when they return to a normal horizontal position.

The foliage of certain conifers, such as some arborvitaes, cryptomerias and junipers, will change their normal green color to brown or purple, especially during abnormal cold. This, too, is a normal condition and is not cause for alarm unless the plants do not return to their usual color in spring.

What if damage occurs?

Once a period of extremely low temperatures has occurred, wait until spring before attempting remedial measures, especially pruning. Even though all the leaves on a broadleaf evergreen may have been killed, it is still possible that the low temperature may not have damaged the wood or that it has not extended too deeply into the woody parts of the plant. It is always best to wait until spring to determine which wood is dead and needs to be removed. Live wood will usually sprout new leaves and branches.

Light fertilizing and making sure the plant does not suffer further stress during the following summer will help get it back on the road to recovery. Mulching trees and shrubs with bark, sawdust or shavings will not only help conserve moisture during the summer, but it will also serve to prevent frost from penetrating so deeply into the soil.

Rhododendron displays signs of cold damage on the leaves.

Sun/freeze damage—this plant is also girdled which is not obvious in the photograph.

In the sad event that the above-ground portion of a shrub has been killed, it is still possible that the crown and roots are in good shape. In spring, the crown should begin to put forth new stems. It is wise to wait until late spring or even early summer before digging a damaged plant out of the ground.

What To Do For Cold-Injured Plants

- Before doing anything, check to find out whether the crown is alive.
- Prune back to live (green) healthy wood. Do not leave stubs. Prune to a bud, stem or trunk.
- Make sure plants are not further damaged by drought. Water properly through the spring and summer but do not overwater.
- Fertilize, keeping in mind the reduced size after pruning when determining the amount of fertilizer needed.

Nandina suffers from damage of repeated freezing and thawing.

Winter Injury Damage Symptoms

Take all symptoms in the context of when they occur. Carefully consider other factors and possible causes for those plant symptoms that become evident after a cold spell.

■ **Chlorosis** (yellowing)—This occurs when chlorophyll production decreases allowing yellow pigments to become visible; yellowing may progress to browning or leaves may drop early.

■ **Necrosis**—Browning or blackening of the leaves results when tissues are killed or damaged.

■ **Purple or red leaves or spots on leaves**—This occurs when chlorophyll production ceases and anthocyanin (red pigment) production increases; red leaves or spots may be triggered by the cold or even day length. Plants recover in the spring and return to a healthy green. This is seen on ivy (between the veins), oregon grape (total leaf), rhododendrons (spots) and salal (patches on leaves). This is a normal occurrence in the winter.

■ **Rolling downward of entire leaves**—This is a protective reaction to cold that reduces the amount of leaf surface exposed to cold or drying winds. Leaves return to normal as the temperature warms. This is commonly seen on rhododendrons.

■ **Leaf drop**—This occurs in some plants as a normal reaction, in others as a protective reaction or as the result of high winds that rip the leaves off. The twigs and branches may be healthy. Nandina and privet as well as other plants do this in the winter.

■ **Drooping of leaves**—This is most dramatic on *Fatsia,* on which the large leaves bend at the stem-end of the petiole and drop flat against the stem, looking as if they are dead. If the plant is not killed by extreme cold, the leaves (even partly damaged ones) will recover and the plant returns to normal when the weather improves.

■ **Bark splitting**—This occurs at the crown (where roots and stem meet) and is fairly common. The bark splits and separates from the wood and girdles the crown. The twigs and leaves above are still alive but the plant is "clinically dead" and there is little hope for recovery. The exception to this is if the roots are able to send up new shoots or if there is only a minor split that may heal (and no girdling). Be careful not to confuse this with chewing injury from root weevil grubs.

■ **Frost cracks**—These are long up-and-down splits in the bark of stems or in the main trunk of the tree. These may be shallow or deep fissures. There are two schools of thought on the cause.

1) The standard theory is that the sun warms cells on the south to west side of the trunk, allowing water to move back into the "winterized" cells. As the temperature drops drastically after sundown, the water freezes suddenly.

2) The most current theory is that all cracks result from wounds or otherwise weakened or stressed tissue, such as is common in recently transplanted plants. Any wound opens the tree to infection and the tree reacts by setting boundaries to stop invading decay or microorganisms. This boundary setting creates stress. After this, any number of events (such as natural growth stresses, sudden heat or sudden cold, wind, etc.) can result in a crack. Two cracks on opposite sides of the tree are considered fatal.

■ **Bud drop**—This condition is much like leaf drop. Perfectly good-looking buds may drop from the plant. This is common on azaleas and camellias.

■ **Dead or damaged buds**—This occurs if the tissue is not genetically able to withstand cold temperatures or if the buds "deacclimatize" on sunny days. Buds may be killed or partially damaged. Some floret buds or tissues may be destroyed and still others remain healthy. This results in deformed or distorted growth, especially on early-flowering plants. Dead buds may become the host of fungi attacking the dead tissue.

Some plants or branches will appear to have escaped winter injury only to fade and die later that spring. It may be that the branch tissue was killed, the bark was split at the crown or the roots (of container plants) were killed but the leaves "don't know it yet."

Winter Injury

Because winter injury is caused by a complex combination of circumstances rather than a single factor, the extent of winter injury will vary. Consider these factors when determining if winter conditions have caused the injury:

Weather Factors

- Winter temperatures that differ from normal.
- Dramatic temperature fluctuations.
- Duration of cold period.
- Time of year that cold occurs.
- Bright sunny days with frozen soils.
- Depth to which soil freezes.
- Drying winds.
- Low humidity.

Detrimental Site Factors

- Proximity of a low-lying body of water.
- Low spot where cold settles (frost pocket).
- Solid fences or barriers trapping cold air.
- Lack or excess of soil moisture before the freeze.
- Lack of a protective layer of mulch.
- Poorly drained soils.
- Exposed wind-swept areas.

Plant Factors

- Genetic hardiness.
- Differences in hardiness of different plant tissue (roots vs. leaves, for example).
- Degree of establishment.
- Condition of the plant (dormant; partly dormant; stressed from drought, fertilizer burn, insects, etc.).
- Location of the plant on the site.
- Protective reactions of the plant (leaf drop, leaf rolling).

Cultural Factors

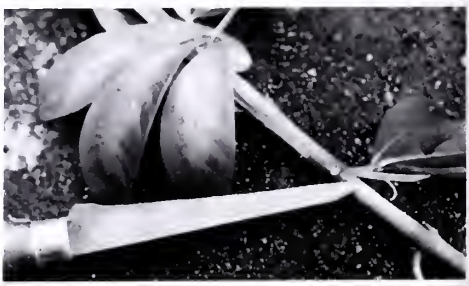
- Excessive fertilization (especially with nitrogen).
- Heavy irrigation in the late summer, early fall.
- New growth caused by the above two factors at a time when new growth would be most susceptible to cold damage.

How To See If A Tree Or Branch Is Alive

Before pruning a sad-looking plant to a nub or pulling it out altogether, check to see if it is still alive:

- Scrape the bark away with a fingernail or make a shallow slanted cut just under the bark with a pocket knife.* Live branches are bright green just beneath the bark. Dying branches show fading green (Don't give up hope yet!) and dead branches are brown and may even be soggy. There is hope for the bright green under the bark.
- Check the tree or shrub in several places: crown, branches and twigs. If outer twigs have died, keep moving towards the trunk until you hit live tissue. You'll find that older wood is more hardy than younger wood.

*CAUTION! When cutting plant material to check for winter injury, use a stainless steel blade. Acids found in the plant sap will often tarnish a common steel blade and the tarnish may be wiped off onto the tissues during the cutting process. This gives the appearance of dead tissue or possibly *verticillium* streaks.

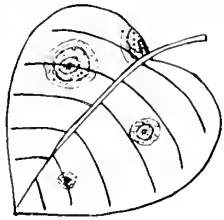


***Live branches** show a bright or fading green when cut just under the bark. Here, the branch is still alive even though the leaves show winter injury.*

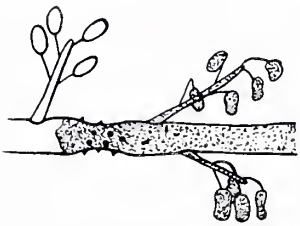
***Brown color under the bark** tells you the branch is dead; it may even be soggy. Check in more than one place, moving towards the trunk until you hit live tissue.*

Cold Injury

- *Leaf scorch caused by winter cold injury.*
- *The line between healthy and dying tissue is very distinct.*
- *Damaged area is somewhat uniform around edge or tips.*
- *Fruiting bodies of saprophytic fungi may attack dead tissue.*



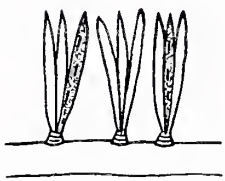
***Sudden dying back** of the shoot usually indicates climatic or chemical cause rather than parasitic disease. If the line between affected and healthy bark is sharp, suspect a soil chemical. If dieback is somewhat more gradual and there is cracking of the bark and wood, suspect winter injury.*

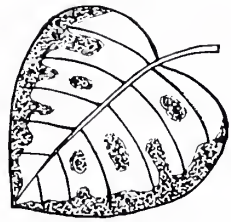


How To Distinguish Between Winter Or Drought Injury And Insect Or Disease Damage

Damage by winter injury or drought tends to:

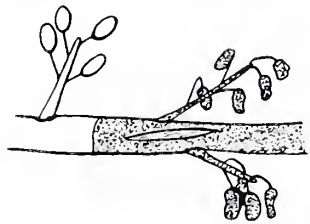
- Be uniform.
- Be worse on the stressed side.
- Have a sharp, distinct or uniform line.



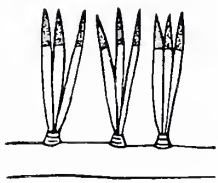


Fungus Disease

- *Leaf spots caused by fungus disease.*
- *Line between healthy and diseased tissue is vague, scattered, irregular and various sizes.*



***Gradual decline** of shoots and retention of dead leaves may indicate a parasitic disease. The margin between affected and healthy tissue is often irregular and sunken. There may be small pin-like projections or bumps over the surface of dead bark. These are the spore-producing structures of the disease organism.*



Damage by insects or diseases tends to:

- Be scattered and random.
- Be scattered through the tree or on the side favoring the pest.
- Have a vague, indistinct or variable line.

Note that exceptions always occur.

Photos courtesy of Flower and Garden

Golden larch (Pseudolarix kaempferi)

On gardens, plants, and CHINA

Rachel Snyder

Close your eyes for a moment, and imagine:

What would American gardens be like without daylilies, chrysanthemums, hostas, camellias, modern roses, peonies, trumpet lilies, spiraeas and forsythias?

You must agree, they would be drab.

Yet those are a mere beginning of the plant riches we have received from China, most of them coming into the western world in the last 300 years.

Of all the fabled treasures laid away in that vast land—and there are many—the wealth in plants is likely the kind that could benefit ordinary people most, and gardeners are first in line as inheritors of these riches.

Gardeners from the U.S.A. visiting China experience a strange "Through the Looking Glass" feeling. The landscape and its plants seem familiar, and yet they don't. The China visitor cannot help looking at the plants and wondering things. China has elm trees; so does North America, but of different species. China has redbuds, dogwoods, catalpas, maples, oaks—all familiar trees to us, but theirs are not exactly like ours. Many other genera could be named that we share.

How can this be, in a land so distant, separated from ours by the widest of oceans? In the young study of continents and of how or when they took their present form and place, plants are sure to be considered as runestones trying to tell us something.

Even to laymen, it is apparent that at some time in the distant past, the land mass of China and that of North America were united. It was at a time of development of many modern plants. Then came a rift, and the land masses diverged, each with its portion of plants.

China lies in a north temperate zone, as do we, in latitudes similar to those of our own country, although China is bigger north to south. Like North America, it has a huge continental mass, with a wide range of terrain, climate, elevations and soils. But there is one great difference: China was never glaciated. In that grim epoch of the pleistocene, when ice sheets capped much of North America and Europe, China and other parts of Asia escaped with their vegetation intact. While many of our plants were ground out of existence, theirs continued to flourish.

So, in a way, China turns back time for us. We can see there now the variety of trees, shrubs and flowers that may have existed here in North America before the ice age arrived.

It stands to reason that many of China's plants, coming from conditions so similar to our own and closely related to them, might do well for us here. It was this feeling that so attracted the great number of plant explorers who have prowled through China over the last 250 years, sending back to the western world seeds, roots, bulbs or pressed specimens. They risked life and limb to do it.

Rachel Snyder is editor-in-chief of Flower & Garden *magazine.*

Reprinted with permission from Flower & Garden, *Oct.*–Nov., 1986.

E.H. Wilson, the most famous of the American plant explorers in China, said it had "the richest temperate flora in the world," with 20,000 different species known, and probably more to be discovered. It was he who called China "the mother of gardens."

Wilson, who at the end of his career worked at the Arnold Arboretum in Boston, introduced thousands of Chinese plants to America and the rest of the world. Not all of them survived the transfer. Nevertheless, you can see a few of his actual introductions growing today at Arnold Arboretum, and gardens coast to coast hold millions of their descendants in the Chinese dogwoods, cotoneasters, tea crabs, beautybushes and regal lilies that did emerge into today's nursery commerce.

He hunted plants in China from 1899 to 1911 in five different trips. The next hunter to go from America was Frank N. Meyer, who explored for the U.S. Department of Agriculture from 1905 until his death in China in 1918. He sent back about 2,500 plant introductions including crown vetch and the ubiquitous Siberian elm. Finally, there was Joseph Rock, who botanized China from 1922 to 1932, discovering many plants, although not introducing many.

In addition to these Americans, there were those from England and Scotland who explored China and sent back plants, starting in the 19th century: William Kerr—for whom *Kerria* was named; Clark Abel *(Abelia),* Robert Fortune, who made enormous contributions; and Augustine Henry. In the present century there were George Forrest whose seven expeditions spanned 28 years; and Reginald Farrer, revered by rock gardeners as an explorer-writer. Frank Kingdon Ward, who lived until 1958, is well remembered to this day by some gardeners who have read his books.

French Jesuits were botanizing in China as early as 1740 with d'Incarville who sent back the tree of heaven *(Ailanthus),* Père David of dove-tree fame *(Davidia),* and Père Delavay. There were also many excellent Russian botanists who collected in China.

Various joint Sino-American and Sino-British expeditions have taken place more recently, but the era of the individual collector is apparently over. Future collecting efforts will probably be team projects under governmental auspices, or scientific exchanges.

Gardening organizations in the U.S. that have sponsored horticultural tours into China since it opened to American tourists in the late 1970's have done a great service in making our garden-minded people more aware of China's plant wealth.

Last spring I took part in such a tour organized by the American Horticultural Society, with Richard Hutton as the sponsor's leader. Hutton, who heads a large wholesale nursery (the Conard-Pyle Co. of Pennsylvania) and is newly elected president of the American Association of Nurserymen, was the perfect person for that spot.

At each of our major stops we devoted an important segment of time to visiting the botanical garden there. At each we were cordially, almost royally, received by the smiling Chinese leaders who were eager to show us their gardens and "talk plants." Language barriers fell away as soon as we got into the botanical Latin of plant names—which both sides understood, even though their pronunciations and ours did not always sound much alike.

From Kunming in the southwest, to Xian, to Shanghai, to Hangzhou, to Lushan, to

Despite the barren look of this hillside of Hua Hong Dong, it held rhododendrons, orchids, a dwarf bauhinia and a white clematis.

Lushan Botanic Garden nestles against a mountainside across a deep valley. A wild cherry is in the foreground.

Wuhan (the "oven of China") we went—everywhere finding excellent gardens in widely varied climatic situations. The array of trees, shrubs and flowers was bewildering. Many were strange to us. These gardens are all fairly new, most having been created since the founding of the People's Republic of China in 1949. The Shanghai garden, with its tremendous collection of penjing and bonsai, dates only to 1974. All are well staffed with trained scientists, and provided with modern facilities for their studies involving economic plants as well as ornamental, and many avenues of research.

Mr. Hutton's notebook and pencil were busy nearly every time I looked at him. I hoped he was jotting down names of attractive plants that U.S. gardeners ought to be able to obtain. Here, I thought, is a splendid mode of plant exploration by a man in a most direct position to make good things happen.

The memory of E.H. Wilson crowded in on us at times. Here we were, seeing China's plants displayed before us in civilized, well tended gardens, along smooth walks or paths, explained and identified by educated hosts. What an incredible contrast this was to the way Wilson saw them earlier in this century, traveling by sedan chair or on foot through bandit-ridden wilderness over dangerous and precipitous trails. The vertical landscapes you see in Chinese art are not exaggerated.

There is still plenty of wilderness in China, and it still has its treasure-trove of wild plants, even though the land has been densely populated and intensely worked for a very long time.

On a mountain path at Lushan we found a tiny violet with a finely dissected leaf, unlike any we knew. The director of the Garden told us it was one of 30 species of violets to be found on that mountain, and was called a "featherleaf."

Later, on a mile-long hike over a high mountain trail, we singled out three different kinds of rhododendrons in bloom—red, yellow and lavender—none of them known to any of us. But we learned that the 200 rhododendron species represented in the Lushan Botanical Garden include many that are indigenous to that area.

From place to place I kept noticing a pretty little blue-purple flower growing in cracks in the stonework. It was a *Corydalis*, of the same family as our North American squirrel corn and dutchman's breeches *(Dicentra)* and bears a resemblance. Here might be a nice addition to our spring bulb gardens, or as a rock plant, I thought, if we could only get it. I never learned exactly which *Corydalis* this was, not surprising as—according to Wilson—China has 58 recorded species of them.

By an odd twist of history, Americans of my generation lived most of our lives in ignorance of China, almost as if it did not exist. This was a loss that can hardly be made up. Our gardens are the poorer for it. Since China was reopened to us in the 1970's, a good start has been made in learning more about China's vegetables, fruits, and other economic plants. Up to now, not a lot has been done on her ornamentals. It is time we started catching up on these. I hope the process has begun.

Knowledge of a Garden's Climate Can Hasten Bloom

Judy Glattstein

For many gardeners, winter is that long gray time of year between the last leaf raking and the first growing plant. This period of time is not connected to the calendar with its arbitrary dates. It is more pragmatic and concerned with what is actually going on in the garden.

As with many other facets of life, winter is not constant. It lasts longer in some gardens than in others. By careful observation of the physical growing conditions in different areas of the garden, variations can be detected. These localized conditions are called micro-climates. The term means variations within limited areas from the normal conditions surrounding them. These small differences may be all that is needed to safely coax a plant into early bloom. Micro-climates can make a big difference in what can be successfully grown.

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Planting zones are those areas of roughly similar conditions as set forth on maps designed by the United States Department of Agriculture. (Another map has also been published by the Arnold Arboretum in Jamaica Plain, Mass.) Seed and nursery catalogues will often state that a plant is "hardy" to a certain zone. This is to give the gardener an idea of the winter temperatures in which the plant will survive.

But there are many factors other than temperature which influence plant hardiness. In the high mountains, under severe conditions of cold and desiccating winds, small stunted twisted conifers survive in the shelter of large boulders. These stunted trees form what is called krummholz and are similar in appearance to bonsai. The protected conditions in the lee of the boulder are a bit less windy, slightly warmer than out in the open tundra. And it is these small variations that make the difference between survival and death for the trees.

Farmers too, have long taken advantage of such variations. The better drainage and more open structure of sandy soil allows it to warm up more quickly in the spring than heavier, denser clay soils. In addition, a sloping field permits cold air to flow away down hill. Such sites are often preferred for orchards and vineyards as they escape late frosts in the spring and early frosts in the autumn.

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Water too, can have an effect. Anyone who has lived by a large lake or the ocean knows how the mass of water acts as a heat sink keeping the nearby garden warmer in early autumn than those gardens that are further inland. Temperature extremes are moderated and summer temperatures are not as high near oceans as they might be away from the coast.

By making use of micro-climates a gardener can advance the flowering of bulbs and early perennials by a couple of weeks. Even if not gardening in the Rockies, producing vintage wine or raising corn, attention to these small variations within the garden can extend the growing season.

When I lived in Norwalk, Conn. I had flowers outside in the garden 12 months of the year. Where I now live is only eight miles away, but those few miles are inland, away from Long Island Sound and on the back side of a ridge along the Merritt Parkway. Now I have winter.

By my definition, it is a time of year without flowers. But my winter is shorter than that of my neighbors. This is so because I am willing to search for plants, especially bulbs, which bloom earlier or later in the year than

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Judy Glattstein teaches and lectures on growing plants.

Reprinted with permission from The New York Times, *March 9, 1986.*

'By making use of the micro-climates, a gardener can advance flowering of bulbs and early perennials by a couple of weeks.'

more common varieties. More important, these special things are planted in a micro-climate that encourages their behavior.

Gardeners can assess their properties now and look for these nooks and crannies — the micro-climates that will extend their gardening seasons through the year. By searching for the less common plants and selecting special micro-climates to encourage and protect their early flowering, a shortened winter is possible.

If the foundation wall on the south side is used for one of these winter gardens, it works especially well. On sunny days the foundation absorbs heat which it releases to the nearby soil and warms the plants.

Winter flowering crocus species are especially good in this type of location. Bulbs are available in late summer to early fall for planting. Early *Crocus sieberi* is a small flowered bulb, about two inches tall, blue-violet with a yellow throat. For me it flowers in late December and early January. If covered with snow, it pops up unharmed when the snow melts. *C. biflorus* is another, especially fine, winter flower although biflorus is a misnomer for each bulb produces not a miserly two but four or five flowers. There is variation within the different sub-species, so that some forms are white, others a soft blue-grey and still others are deeper purple. Flowering time is mid-February to early March.

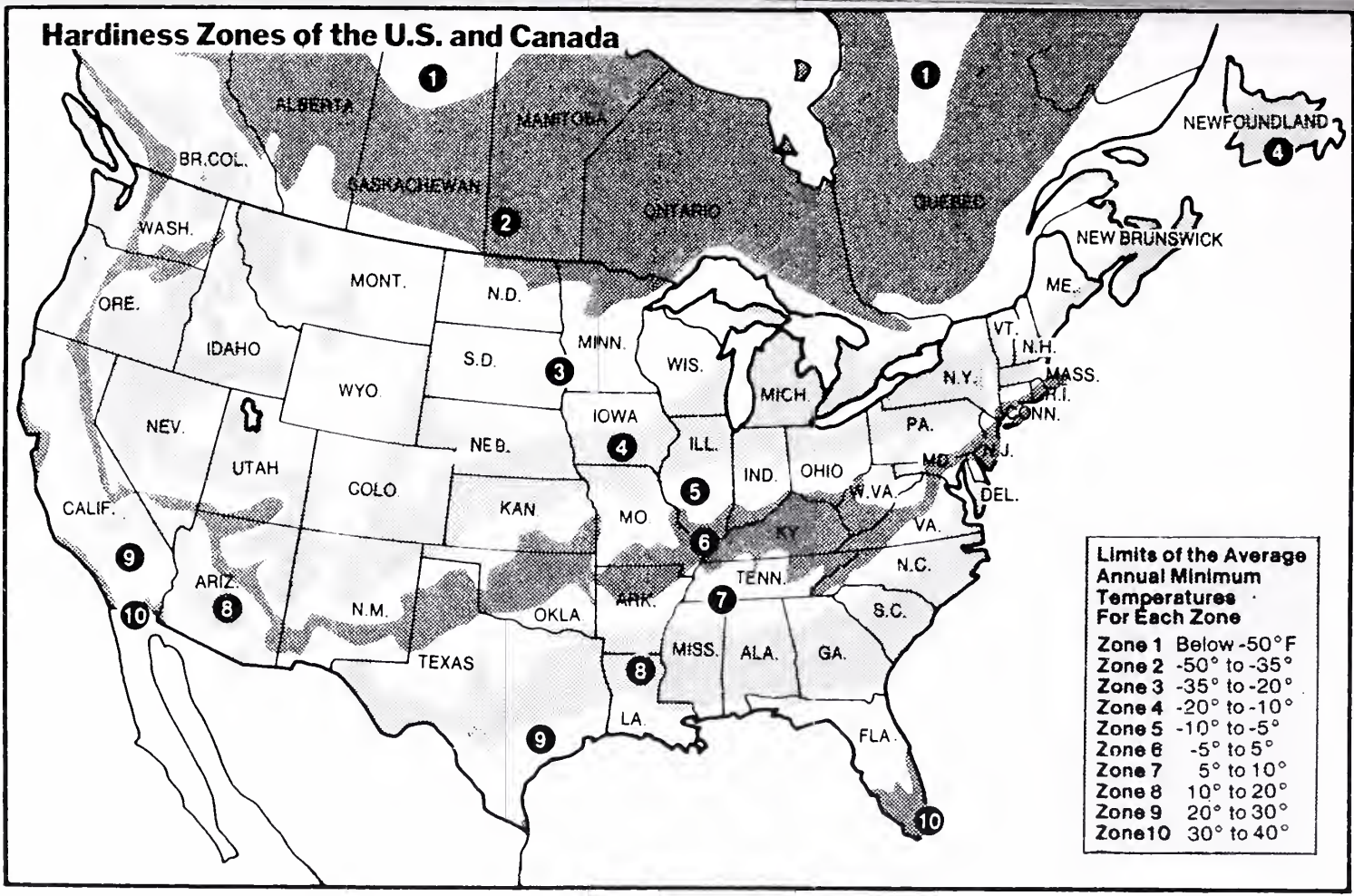
C. chrysanthus is generally available in a number of named selections. There is a wide color range from pale golden yellow to white, pale blue and deep blue. Flowers are freely produced and appear in early to mid-February. A real prize is *C. laevigatus fontenayi*. The name is nearly bigger than the plant. This little crocus is a pale lilac mauve with the outer three petals marked with purple. The flowering season begins in late November and extends until the end of January.

Snowdrops are often a welcome sight early in the year. Given a protected sunny location the common *Galanthus nivalis* will often begin to bloom in mid-February. Larger in size and variable in flowering time is *G. elwesi*. This bulb can flower anytime from January onward.

Winter aconite *(Eranthis hyemalis)* is a cheerful little yellow flower that begins to bloom in February. The color is so vivid that it will shine through a light covering of snow. Slow to establish, winter aconite will re-seed and spread once it settles down.

There are a few winter flowering perennials that I can testify will "do their thing" while the rest of the garden is dormant. A favorite is the Japanese *Adonis amurensis*. The plant makes its appearance in the woodland garden in February, if the season is typical. I have had it appear in January in a mild winter, March if the weather is really severe. The buds are like a satiny green taffeta ball opening to a golden daisy held above finely cut foliage. By May, the plant has gone dormant again, to wait for the next year.

Pulmonaria rubra is another early bloomer showing clear soft pink flowers above green unspotted foliage in February. Often the same plant will remain in bloom until late April. There are more, *Helleborus orientalis* and *H. niger* are both winter


Hardiness Zones of the U.S. and Canada
ALBERTA
MANITOBA
BR.COL.
SASKACHEWAN
ONTARIO
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
WASH.
ORE.
MONT.
N.D.
MINN.
IDAHO
S.D.
WYO.
WIS.
MICH.
N.Y.
VT.
N.H.
ME.
MASS.
R.I.
CONN.
NEV.
UTAH
NEB.
IOWA
ILL.
PA.
N.J.
MD.
DEL.
COLO.
KAN.
IND.
OHIO
W.VA.
CALIF.
MO.
KY.
VA.
ARIZ.
N.M.
OKLA.
ARK.
TENN.
N.C.
S.C.
TEXAS
MISS.
ALA.
GA.
LA.
FLA.
1
2
3
4
5
6
7
8
9
10
Limits of the Average Annual Minimum Temperatures For Each Zone
Zone 1 Below -50° F
Zone 2 -50° to -35°
Zone 3 -35° to -20°
Zone 4 -20° to -10°
Zone 5 -10° to -5°
Zone 6 -5° to 5°
Zone 7 5° to 10°
Zone 8 10° to 20°
Zone 9 20° to 30°
Zone10 30° to 40°

Temperature Equivalents for USDA Plant Hardiness Zones

Zone Number	Average Annual Minimum Temperature (°F)
1	below −50°
2a	−50° to −45°
2b	−45° to −40°
3a	−40° to −35°
3b	−35° to −30°
4a	−30° to −25°
4b	−25° to −20°
5a	−20° to −15°
5b	−15° to −10°
6a	−10° to −5°
6b	−5° to 0°
7a	0° to 5°
7b	5° to 10°
8a	10° to 15°
8b	15° to 20°
9a	20° to 25°
9b	25° to 30°
10a	30° to 35°
10b	35° to 40°

A hardiness-zone map of the continental U.S. may be obtained for a fee of 25 cents, by writing to:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402.

Ask for Miscellaneous Publication #814.

flowering plants. *Primula abchasica* will show its vivid magenta/cerise buds in early February.

Suggested sources, bulbs: John D. Lyons, Alewife Brook Parkway, Cambridge, Mass., 02140, list in late summer; perennials: Carroll Gardens, Westminster, Md 21157, catalogue $2; Holbrook Farm & Nursery, Fletcher, N.C. 28732, catalogue $2; Wayside Gardens, Hodges, S.C. 29695, catalogue $2; White Flower Farm, Litchfield, Conn. 06759, spring-fall catalogues, $5.

Winter Map Update

Many a gardener and professional horticulturist has on more than one occasion wished for a more contemporarily accurate and detailed hardiness zone map than those compiled by the U.S. Department of Agriculture in 1960 and the Arnold Arboretum in 1967. Dramatic changes in weather patterns over the past decade have pointed up the need for revision of these vital references.

Considerable research on this subject has been done by Meteorological Evaluation Services (165 Broadway, Amityville, NY 11701). This company has produced a report ($4.95) with maps and suggestions for updating hardiness zones based on current winter weather.

A brand new hardiness zone map has been developed by a landscape architect with the aid of a computer. Called the Flora Adaptability to Winter Map, it is the basis of "The Best of the Hardiest," by John J. Sabuco (Good Earth Publishing, Box 104, Flossmoor, IL 60422; $19.95 plus $3 shipping).

Mr. Sabuco's zones take into account average and record low temperatures and the amount of snow, wind and cloud cover. Detailed data on plants and climates was collected by Mr. Sabuco and his staff in the Chicago area, and by Club Moss, a network of experienced gardeners solicited by newspaper ads and through garden clubs across the Midwest. Over 5,000 plants were observed, and 1,700 of the hardiest and most ornamental are described in the book, with cultural recommendations. Many are illustrated by line drawings.

Mr. Sabuco also describes how the data was computerized, and includes chapters on culture, planting, and breeding for hardiness. His book will be valuable to anyone gardening where winter temperatures go down to −20°, and as a general hardiness reference anywhere in the country.

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Meadow Gardening

Donna Levy

In recent years the cultivation of wildflower meadows has been of burgeoning interest in the Northeast. Attractive photographs of fields with colorful wildflowers seen in magazines and catalogs, combined with the misconception that meadow gardening is maintenance free, have probably contributed to its growing popularity. Now many seed companies are promoting that approach to gardening and are flooding the market with "meadow mixes."

Meadow gardening is in its infancy in the Northeast. There is much to be learned about it, and there may be some ecological concerns related to it. Successful meadow gardening is dependent on understanding the nature of meadows and learning what is involved in creating one. It is helpful if the gardener has a basic understanding of plant succession: a natural process whereby one assemblage of plants is replaced by another until a climax situation is reached. Climax situations are capable of sustaining themselves. For example, in the Northeast, woodlands dominated by red oaks, black oaks, and white oaks constitute a climax condition.

Next, it is necessary to understand what a meadow is and where one occurs. A natural meadow is a perpetual grassland—a habitat of rolling or flat terrain where grasses predominate. Natural grasslands are climax ecosystems maintained by environmental factors that restrict the growth of woody plants. For instance, alpine meadows occur at high elevations and are maintained by harsh climatic conditions. Coastal meadows are maintained by salt sprays, and desert meadows by low precipitation. Prairies, the grasslands found on the continental plains of the Midwest and the West in North America, are maintained by periods of severe drought and are subject to fires.

What we often refer to as a meadow is more likely an old field that is in a state of early succession and destined to become woods again if left undisturbed. After farmland has been abandoned, grasses and other herbaceous plants will colonize its fields. The condition is only temporary, however, because the early colonizers will be shaded out when woody plants invade. Such sites must be intentionally kept in that state to maintain the meadow community.

In the Northeast the plants growing in disturbed sites are chiefly non-native. Such sites contain many Old World species that were inadvertently brought to this country in ship ballasts and livestock bedding, or that were intentionally imported for use in gardens or research projects. Those that escaped and were able to compete successfully with native species were naturalized and became what we loosely call wildflowers.

Many companies offer assortments of wildflower seeds, but be forewarned that your success with mixtures will depend somewhat on your careful evaluation of them. Beware of the pretty picture on the packet or the can and the enticing name of the mix. The picture may be the most attractive thing offered.

Most mixes contain combinations of seeds from midwestern and western native wildflowers, as well as seeds from exotic wildflowers (species from foreign countries). Some mixes contain seeds of species already naturalized in our part of the country, but

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relatively few mixes contain species native to the Northeast. Mixes often have seeds of both annual and perennial plants.

Some commercial mixes include potentially invasive or noxious weeds. For example, companies may incorporate seeds of purple loosestrife (*Lythrum salicaria*) in their mixes. Although it is very attractive, purple loosestrife should be avoided at all costs. It has become an environmental pest and is posing a real threat to native wetland habitats. It is now found growing invasively through valuable wetlands in the Northeast and has moved into the Midwest and parts of Canada. The plant out-competes wetland species that are beneficial to wildlife, such as rushes, sedges, cattails, and smartweeds. Purple loosestrife is not a food source for most wildlife, and its stems and roots trap debris over a period of time, slowly raising the surrounding ground level. Three years ago it was estimated that purple loosestrife had successfully invaded over one thousand acres of the six-thousand-acre Montezuma marshland refuge at the north end of Cayuga Lake. The plant was first recorded as being sparse there in 1951, but within five years an estimated equivalent of one acre of purple loosestrife was growing there.

The New England Wildflower Society has compared mixes from twenty-one of the companies that offer wildflower seeds and has compiled a very helpful chart. The chart lists the companies, the name of the mixes they offer, the number of species in each mix, and the percentage of species native to the Northeast in each mix. Comments are included as well. To obtain a chart, write to the New England Wildflower Society, Hemenway Road, Framingham, Massachusetts 01701.

Wild parsnips, ox-eye daisies, and crown vetch bloom in the wildflower garden.

Some Predictions

Assume you sow a wildflower-seed mix in a tilled area and perform no other cultural practices, such as weeding or watering. If that mix contains exotic annual species, the following is likely to happen: the first year, the annuals will bloom, making an impressive show, but the plants will probably disappear by the next season. Very few, if any, will self-sow. If that mix consists of commonly naturalized wildflowers along with other wildflowers, the naturalized wildflowers that have already proven themselves tough in the area probably will out-compete the less aggressive types. Finally, if that mix doesn't contain species already naturalized in the area, they probably will invade anyway, since tilling the field will have created an optimum condition for the growth of common weeds (naturalized wildflowers). You are most likely to succeed with mixes that contain native species, such as goldenrods and asters, and already naturalized species, such as chicory and black-eyed susans. That being the case, you might wonder why you should sow anything at all after tilling.

Photos by Joan Ishell

Purple loosestrife

Suggested Approaches

If you are interested in experimenting with meadow mixes, here are some general pointers. First, consider that you must approach the effort as you would any gardening venture. Scattering seeds over a weedy field will not produce an ornamental meadow: Success is most likely if you choose a small area, one that you can weed and tend easily while your meadow is establishing itself. The soil should be tilled and smoothed out as it would be for a planting bed. Tilling, however, is likely to bring to the surface many weed seeds that have lain dormant. Many a meadow gardening attempt has failed when the weeds triumphed, so be prepared with a plan for weed control.

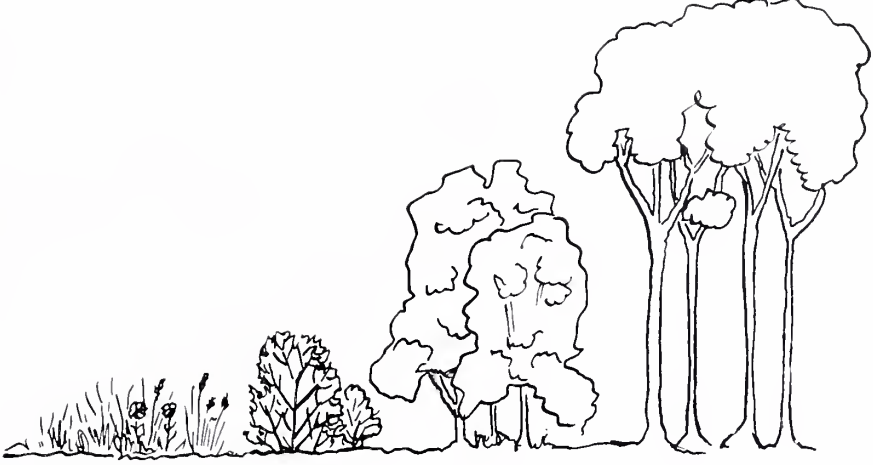
Choose a mix most suitable for your site; consider soil moisture, available light, preferred season of bloom, plant heights, and your geographical region. Seeds can be sown in spring or fall. Fall sowing is often recommended because weeds may be less of a problem at that time of the year, and seeds requiring a period of cold before they germinate would have their requirement met during the winter. Annual mixes can be sown in the spring, but that means tilling and sowing seeds every year to maintain the meadow. Once your seeds have been sown, keep them moist so that they can germinate. And after the wildflowers have germinated, remember that moisture will be necessary so that the new plants can establish themselves.

Learn to recognize the seedlings you want to encourage, so that you can weed the plot. You will probably need to keep up with the weeds for the next two or three years.

When established, the meadow should be cut once a year in the spring for uniformity and to discourage the growth of woody plants. Some wildflower gardeners recommend fall cutting, too, but not until after the plants have matured their seed, to ensure that there will be a source of new seeds. Cut the meadow high by hand with a scythe. A lawn mower cannot be set high enough for the job.

Now, stop to consider whether you have the time, resources, and enthusiasm to do all that on a large scale. For more detailed information I recommend an article entitled "The Return of the Wildflowers," published in the April-May 1984 issue of *Flower and Garden.* Another excellent reference recently off the press is a book by Laura C. Martin entitled *The Wildflower Meadow Book.*

An alternative would be to try something akin to an experiment being conducted by the New England Wildflower Society at Garden in the Woods. Their method, too, is labor intensive, and you will find that the more elaborate the meadow is, the more demanding the kind of gardening required. For their project, after preparing the site, the New England Wildflower Society introduced three thousand nursery-grown plants into a quarter acre. They had selected thirty species of competi-



Drawing by Margaret Corbit

tive wildflowers that are native or naturalized in the northeastern part of the country. Then they sowed native grass seed at two times the recommended rate. Grasses were used because they are an integral component of natural meadows and will aid in weed control.

Another approach resulting in a somewhat different effect is what we have done in the Mundy Wildflower Garden at the Cornell Plantations. By mowing it annually we intentionally keep the meadow in the temporary state of early succession I referred to earlier. A few years ago we removed all the woody species that had started to invade the site. The area was tilled, and we planted a modest number of native plant seedlings that thrive in full sun. Then we just sat back and let nature take over. Today, although some natives persist, it is a good place to see and study the kinds of non-native wildflowers that have become naturalized along roadsides and in old fields in our area.

Last summer we ran some small test plots, sowing four different mixes from one company. In June we prepared the four ten-by-fifteen-foot beds and sowed three-quarters of an ounce of seed on each. The plots were weeded by hand once in August, just about the same time the first blooms appeared. The blooming plants were annuals and were either exotic or western wildflowers. I'm curious to see what happens this coming season. My guess is that the annuals will not persist, and it will be interesting to see what becomes of the perennials in those mixes.

Some Ecological Concerns

Some seed companies pride themselves on offering seeds collected in the wild by professionals. Plants that produce abundant seeds may not be endangered by that activity, but I wonder whether the seed collectors' activities will deplete the seed sources of some species of prairie plants. Today less than one percent of our nation's prairies exist in their natural state. Instead wheat and corn fields occupy that ground. If seeds sold in meadow mixes don't naturalize, then we aren't perpetuating or preserving the species. Will we be noticing a detrimental impact on the natural populations years from now?

I am also concerned about the potential consequences on native flora of introduced wildflowers. If, for example, we introduce species of goldenrods or asters that are not native to an area, is there a chance they will out-compete the native species? I suspect that even if the seeds of regional species are included in the mixes sowed in the region, the seeds are likely to be different varietal forms, and I'm curious about whether the introduction of geographic strains from another region will have an adverse effect on local varieties of native plants. Is there a potential for disturbing the natural balance of our wild flora once the interactions of pests, diseases, and other environmental pressures come into play?

I don't want to discourage determined gardeners from trying a wildflower meadow if they are prepared for the work it entails. Following one of the three approaches I have discussed should ensure success. Keep in mind that commercial seed mixtures should be used only in a plot small enough to be cultivated, and that on a large scale, only species sure to naturalize should be used. Your final option is to till up the ground every year and sow annuals.

Ruminations on
KITCHEN HERBS

Frederick McGourty

One candle-lit evening a dozen years ago, my bride-to-be enticed me with my first pesto, that ethereal sauce combining fresh basil leaves and garlic. It was love at first bite, and I wondered where this delicious and versatile concoction— equally at home on top of spaghetti or in soup—had been all my life. Certainly not in the staid Italian restaurants of my youth. Admittedly, I had a protected childhood; the principal culinary work in our home was the 1943 edition of Irma Rombauer's *Joy of Cooking*, which didn't mention pesto at all and included just a couple of fleeting references to garlic. In those days, garlic wasn't often used west of the Hudson River, except in bad jokes.

That was the era of creamed vegetables, chicken à la king and chipped beef, not to mention casseroles. The only basil that was known to Main Street Americans had the last name of Rathbone.

Basil, garlic, tarragon and a host of other herbs have come a long way since the 1940's, and the herb garden itself is no longer the preserve of slightly dotty, generally harmless old women whose closets smell of lavender sachets. Even *Joy of Cooking* has been liberated, and revised editions by Marion Rombauer Becker and Irma Rombauer recognize pesto. Culinary herbs have come into the mainstream as our diets and tastes have changed. As a result, American cooking is much more imaginative than it used to be, and the sale of herb plants has boomed.

Herbs always used to be grown together in one section of the garden, and herb gardening evolved somewhat separately from other kinds of gardening. Indeed, there was a special lore associated with herbs, and there was comfort in having the traditional plants bound together in tidy rectangles of dwarf boxwood and lavender. Plant culture was frequently made easier, too, because many of the basic herbs have similar growth requirements.

A Pickle Among Dills

Even today, a good case can be made for keeping herbs intended for culinary use separate from plants grown exclusively for ornamental purposes—if the latter are going to need spraying. More than once I have inadvertently showered the feathery leaves of dill with a systemic fungicide meant for summer phlox, which gets mildew as readily as a dog gets fleas. (Systemic, it should be remembered, refers to poison taken up *within* the plant.) Since I don't like dill, my wife accused me of absent-mindedness the first time, and of sabotage the second. I lamely replied that one can be absent-minded twice.

Ever since then, Mary Ann has grown dill only in the vegetable garden, where no systemic pesticides are used, and we reserve the ornamental bronze-leaved fennel *(Foeniculum vulgare* 'Atropurpureum') for spots in the perennial border where a gossamer effect is desired. The height of this anise-scented herb is about four feet. Plants are short-lived perennials, but usually self-sow, sometimes to the point of being pesty in mild climates. They consort well with the cherry-red, summer-flowering *Phlox paniculata* 'Starfire' or the white-flowered cultivars such as 'Mt. Fuji' or

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Salvia officinalis *'Purpurascens' combines well with parsley.*

the September-blooming 'World Peace.' *E. vulgare* 'Atropurpureum' mingles nicely with taller sorts of silver-leaved perennials, too, including *Artemisia ludoviciana* and its kin, 'Silver Queen' and 'Silver King.' Fennel leaves have an anise taste that Mary Ann doesn't like, so no part of the plant ever reaches our kitchen table, spraying or no spraying. The art of gardening has a lot to do with marital compromise.

In most gardens, there are a few sound reasons for incorporating herbs where they will best fit in aesthetically, rather than having them isolated in a single area. Most gardens today aren't large enough for specialized plantings. Also, although the carefully designed herb garden is a joy to see in May and June, it usually becomes unkempt by midsummer unless many of the rank-growing sorts—and there are many—have been cropped almost to the ground. Of course, until lush new growth reappears, this kind of drastic pruning leaves gaping holes, which are all the more conspicuous if a number of wayward herbs are planted together.

Some traditional herbs are first-rate ornamental plants, and it seems a shame to restrict them to a little corner of the garden instead of casting them into the mainstream, as is usually done in England. Once, when designing a perennial border for a client, I mentioned that I planned to work in some sage and lavender because of the buffering effect their cool gray or gray-green foliage has on other plants. I was taken aback by my client's reaction: "But they are herbs, and I want a *perennial* border." I was tempted to inquire whether she wanted a ghetto or a garden, but temperance prevailed, and gray-leaved artemisias were substituted. The fact that artemisias are considered herbs in the conventional sense, or indeed that most herbs are perennials, was lost upon her, but I do hope she is enjoying her perennial border.

A Kitchen Border

Mary Ann and I like to grow a wide range of plants and have no formal herb garden as such. Near our kitchen door, however, a small border does include a mixture of kitchen herbs and a few ornamental sorts that haven't been used much lately, such as lady's-mantle *(Alchemilla mollis),* which alchemists employed in the Middle Ages. This species grows a foot tall and tolerates dry shade better than most plants do. It has handsome, blocky, gray-green foliage with pronounced lobes, and water has a way of forming glistening, almost silvery beads on the leaves after a rain or a dewy night. The chartreuse flowers, which appear in June, are esteemed more by flower arrangers than by zinnia growers. However, they are quite pleasant when combined with *Gaillardia* and *Geranium* 'Johnson's Blue.' Should we forget to remove the inconspicuous clusters of spent *Alchemilla* blossoms (as is often the case during an indolent July), there are seedlings growing in awkward spots the next year. But,

Salvia officinalis *'Purpurascens' is planted here with* Lavendula angustifolia *providing pleasing textural contrasts.*

it takes just a few minutes to remove the unwanted plants—if we are in a tidying mood. The excess plants are then moved to a nursery area, potted and eventually sold.

Our kitchen border is convex, curving for a length of 22 feet to extend the line of a small back porch—one that is just large enough for two deck chairs, a grill, four cats or one Labrador retriever, and an inordinate number of potted plants. The border is six feet wide at its broadest point and is bounded by lawn on one side, and on the other, by a fieldstone path so we can weed in the back of the border without stepping into it any more than necessary. (Most plants, including herbs, grow best in fairly loose earth that roots can penetrate readily, and they falter in soil that is compacted by human feet.) Between the fieldstone path and the house are several shrubs, near the base of which lady's-mantle consorts with scillas, a hellebore or two, and oriental adonis, each planted for an early-spring serenade. The border faces southeast, and most of it receives six hours of sun—just enough for the sun worshippers, which most herbs are—but the back part is shaded by the shrubs.

The shrubs are a mixed lot, including an uncommon spice bush from the Orient, *Lindera angustifolia,* whose aromatic, narrow leaves turn brilliant tawny-orange, then buff-colored, before falling in late autumn; a Japanese holly that resembles the traditional herb garden accompaniment, English boxwood, which we avoided because its brittle branches break easily in heavy snows; and a hybrid yew, which has been kept sheared to three feet high and eight feet wide, and protects some of the herbs from the hot afternoon sun.

Sweet cicely *(Myrrhis odorata),* a stout-growing herb with finely cut, light green foliage like that of the lady fern, grows here and there among the shrubs, softer than the somber green foliage of the yews and providing a lacy contrast to the holly. This plant is a charmer, with flat clusters of white flowers that appear in May and inch-long, anise-scented seeds that I find refreshing to chew on a warm June day. In fact, every part of the plant has an odor of anise. I occasionally add a few fresh chopped leaves to a salad as a welcome change of pace from tarragon *(Artemisia dracunculus).* (Tarragon, incidentally, is one of the least attractive plants in the garden and should be placed where it is inconspicuous.) A sprig of sweet cicely in iced tea is unexpectedly pleasant, too. These plants perform best in partial shade. To forestall the premature yellowing of foliage that is sweet cicely's weak point, and to encourage a flush of good foliage late in summer, we frequently cut stalks back sharply in late June. Plants grow three to four feet tall and are vigorous enough to emerge through pachysandra.

Alliums for All

Times change, and the ubiquitous sour-cream-and-chives topping for baked potatoes 20 years ago has become, in our cholesterol-conscious era, yogurt and chives. Chives are eternal in the garden of any good alliumphile, and they can even overcome yogurt. The principal culinary species is *Allium schoenoprasum,* which makes a hummock of rounded, but otherwise grass-like leaves and bears dainty flower clusters that run the gamut from lavender to pink in May or June—quite a pleasant sight with blue or white columbine. This is the ideal cut-and-come-again crop, since a few leaves here and there can be taken for a salad, or, even more drastic, the plant may be given a crew cut if a lot are needed. The foliage grows back in several days. If you forget to buy onions at the market, you can always substitute the somewhat milder-flavored chives. Just two or three plants are ample for most families.

It is best to avoid using chives as an edging for a border surrounded by grass. The foliage is too similar, and inevitably, the grass will sneak into the clumps when your back is turned. Instead, I would suggest putting a few plants of *Veronica incana* in front. This species' low, gray foliage sets off chives well, and its spikes of blue flowers, which grow to about 10 inches tall, complement the chives' bloom.

Allium is, of course, the generic name for onion, and there are 100 or so species growing wild somewhere in the world, a fact that I enjoy contemplating. Oddly enough, the common onion *(Allium cepa)* is of garden origin and is not known in nature, but I will hardly discriminate against it for that reason. Many of the alliums are fine ornamental plants if the spent flower clusters are removed and not allowed to set seeds, which often have a higher fertility rate than rabbits. Some alliums, it must be admitted, are weeds, and the world cannot eat enough of them to keep the upper hand. A certain number of alliums, including shallots, leeks and garlic, elevate cooking from the mere preparation of food to the status of an art.

Traditional chives (*A. schoenoprasum*) are of modest garden merit unless one is lucky enough to have a form with either clear pink flowers or blossoms that are borne well above the foliage tufts. In the border, I prefer the garlic chive (*Allium tuberosum*), which has strap-like leaves (easier to harvest and prepare), grows to 2½ feet in height, and bears three-inch-wide clusters of white, star-shaped flowers in late summer, when bloom in many gardens is sparse. The taste of the chopped foliage is more pungent than that of common chives, but I have never thought of it as garlicky, despite the common name. Kitchen chives are for relatively subtle dishes, while garlic chives are better suited to Braunschweiger and pumpernickel sandwiches.

Suitable garden companions for garlic chives in a sunny spot include pink turtlehead (*Chelone obliqua*), *Physostegia* 'Bouquet Rose' and Japanese anemones, all of which are in the three-to-four-foot category. Another potential mate is 'The Fairy' rose, with its abundant, small, pink flowers. You might try some low-growing blue plumbago (*Ceratostigma plumbaginoides*) in the foreground. Bear in mind that garlic chives can also soften the brassiness of late-summer yellow composites such as rudbeckias and heleniums.

Allium senescens has no common name, although it is grown under a number of other botanical names not currently recognized by botanists. This is another species of chive that combines utility with attractiveness. Because it is native over a very wide range (from Europe to the Pacific), the gardener might expect this species to be variable, and indeed it is. One common garden sort has flattened, green leaves with a pronounced twist; its pink flowers have a lavender tinge and are borne in flat clusters on top of 18- to 24-inch stalks. Blooms appear in midsummer. Although not an exciting plant in itself, it complements purple coneflower (*Echinacea purpurea*) well, softening that perennial's raspiness when it is used in quantity.

The twisted chive, *Allium senescens* var. *glaucum*, a Far Eastern variety of *A. senescens*, is a lovely end-of-summer bloomer. It is only six or seven inches tall when the rosy-pink flowers open in August. The gray-green leaves are sickle-shaped and, when new growth begins in spring, are arranged horizontally in a characteristic circle. To be truthful, the foliage is so nice I haven't had the heart to pluck it for salads. Twisted chives look well in a raised bed, especially if they are allowed to mingle with the common annual edging plant, sweet alyssum (*Lobularia maritima* 'Carpet of Snow'). They are also attractive in small groups toward the front of the border. As with other alliums, the site should be sunny and the soil well drained. However, these are not fussy plants.

Curly Parsley

One of the handsomest edging plants for a border is parsley (*Petroselinum crispum*), at least the curly-leaved sort that one sees today. It is refined and goes well with practically everything in the garden, as it does in the kitchen. Parsley is a biennial; the slow and erratic germination of its seeds led to the old saying that parsley seeds go nine times to the devil and back before coming up, and he keeps some of them. Instead of growing parsley from seed, we buy young plants in spring

and set them six inches apart in the front of a border. Sprigs are available for picking all summer, and in autumn we pot several plants to grow during the winter in the kitchen. Parsley does not transplant well, so we pot a couple more plants than are actually needed. Once adapted to the house, they put up with subdued light and low temperatures, but they need to be watered more often than most plants. They usually stagger through to March unless the whiteflies get the best of them.

We sometimes let parsley overwinter in the garden. In spring, these second-year plants produce a flush of new foliage for a month or two, but then flower and die. To avoid gaps, parsley is therefore best treated as an annual.

In ancient times, parsley was associated with death, and victors at funeral games in Greece were given wreaths made from it. Later, the phrase "to be in the parsley" was used in reference to someone on the deathbed. The term "Welsh parsley" meant the gallows.

Parsley happens to be of Mediterranean origin, but it is not at home in the parched surroundings one associates with that region. Plants grow best in garden soil to which compost or peat moss has been added. The site need not be in full sun, and if the soil is not moisture-retentive, plants should receive light afternoon shade.

Bear in mind that parsley's foliage lends a fresh spring-green color to the garden until December, even in a very cold climate. A prolonged garden scene can be produced by grouping parsley with lamb's-ears (*Stachys byzantina*), *Lamium maculatum* 'Beacon Silver', *Lamiastrum* 'Berman's Pride', *Pulmonaria* 'Mrs. Moon', *Salvia officinalis* or *Lavandula angustifolia*, all of which have long-lasting, silvery or gray-green leaves. Parsley also looks well with the reddish, late-season foliage tints of coralbells (*Heuchera*), *Bergenia* or *Epimedium* × *rubrum*. You can even eat it if it gets to be a bore, although most people are happy just toying with it on the plate.

Mints

The mints are not very good garden plants because they spread so rapidly underground, but it is nice to have a patch or two near the kitchen door if friends drop in unexpectedly for dolmas or juleps. Peppermint and spearmint fend for themselves quite well on poor sites and are thoroughly at home in light shade. Ideally, they should be planted to one side, out of the garden, and kept honest by the blade of a lawn mower. Running water nearby makes them really romp, but such a rare site should be reserved for watercress.

In the garden, mints are thugs, and they should be fully recognized as such before they abuse the rights of fellow herbs with less invasive root systems. The solution, of course, is confinement—in a bucket sunk in the soil, with the rim slightly above ground level, for they will try hard to escape. Old plastic wash buckets work well. Brown buckets, which blend with the surroundings, are preferable to kelly green ones. Poke a few holes in the bottom of the bucket with an ice pick to allow for drainage. Every two years it will be necessary to take up the mint and set it back again in replenished soil, but this procedure is preferable to pulling the strands of its invading roots from choked plants nearby every year.

For kitchen use, I am fondest of apple mint (*Mentha suaveolens*, formerly *M. rotundifolia*), whose rounded, inch-wide, hairy leaves are easy to pick and are excellent for iced tea. A variegated cultivar called pineapple mint (*M. suaveolens* 'Variegata') appeals to some; to others, its cream-and-green leaves suggest herbicide injury. Orange mint (*M* x *piperita* var. *citrata*) is esteemed more highly by some menthologists. For gardening beauty, perhaps the nod should go to the variegated ginger mint (*M.* x *gentilis* 'Variegata'), which has yellow and green leaves that bring a welcome brightness to a dark corner. This cultivar has extremely invasive roots and surely deserves solitary confinement. Variegated ginger mint grows about 15 inches tall; the others range from two to three feet in height. If a tiny, prostrate sort is desired between stepping stones try growing Corsican mint (*Mentha requienii*). This species resembles mother-of-thyme but has a strong mentholated odor. In winter in northern regions, it is short-lived, so one or two plants are best kept in a cold frame during the cold months.

Lamb's ears (Stachys byzsantina) *is a pleasant partner for curled parsley* (Petroselinum crispum).

Basil

Basil (*Ocimum basilicum*) has been associated with the Mediterranean region since ancient times. This annual herb is, in fact, native to the tropical parts of India, where it is considered sacred. (The name basil means kingly or royal.) The plant made its way to Greece via the earliest routes of trade, and Greeks and Romans thought of it in sinister terms. Keats' tale of Isabella, inspired by Boccaccio, recounts how she preserved her murdered lover's head in a pot of basil, watering the plant with her tears. I figure the skull must have been a slow-release fertilizer of sorts, providing phosphorus for the healthy growth of the basil.

Basil doesn't need a very rich soil. Pesto addicts usually choose to grow basil in the vegetable garden because of the prodigious amounts of foliage needed for their sauce. This choice may be just as well, for the common kitchen basil is a rather nondescript plant, and the pretense of ornament can be dropped altogether within the row system of the vegetable garden. It is more appropriate to save the space in the kitchen herb border for bush basil (*Ocimum basilicum* 'Minimum'), which is tidier, or better still, for 'Dark Opal', a maroon-leaved seed strain of common or sweet basil that was developed some years ago at the University of Connecticut. Rue (*Ruta graveolens*), whose lacy but bitter, gray foliage is seldom used in the kitchen anymore, makes a fine background for 'Dark Opal'. From a distance, the combination of their foliage gives a flowering effect all season long. However, rue's foliage can present a problem to the gardener, as noted many years ago by Dioscorides; "If any one rubs his Face with the hand that gathered it, it will immediately raise a violent Inflammation." On a hot day, some gardeners may indeed develop a bad rash from touching rue.

An annual, basil is grown yearly from seed. Although the seed is easy to germinate, seedlings are subject to rot if over-watered, and many gardeners elect to buy young plants from garden centers after the danger of frost has passed. In the border, basil performs best during hot summers. Common basil grows

about 18 inches in height; 'Dark Opal' is usually under 15 inches tall. Rue, a perennial, is apt to be short-lived in colder parts of New England, especially if winter drainage is poor. Young plants are usually available from garden centers in spring. Both common basil and 'Dark Opal' enjoy full sun.

Sage, Bay and Rosemary

Kitchen sage (*Salvia officinalis*) needs the same growing conditions as 'Dark Opal' basil and rue, and thus makes a good companion for these plants. The typical kind has gray-green leaves of respectable substance and is more versatile in the garden than in the kitchen (though a New England sausage-maker or a British duck-stuffer might disagree). This low-growing Mediterranean shrub is a straight man—not striking in its own right, but an excellent complement to those plants with maroon foliage, or with pink or lavender flowers. Kitchen sage is quite variable. To me, the most attractive cultivar is *S. officinalis* 'Purpurascens', whose new leaves are tinged with purple. It makes a sumptuous tub plant and goes well with companions that have subdued pink flowers. I am fondest of it with purple sweet alyssum (*Lobularia* 'Royal Carpet').

Like many pungent herbs, sage was originally used for medicinal purposes. (The botanical name for the genus *Salvia* comes from the Latin *salveo,* meaning "to be well.") It was associated with immortality, and was also believed to have teeth-cleaning and gum-strengthening properties. One old proverb queries, "How shall a man die who has sage in his garden?" Just as old Soviet Georgians today might attribute their longevity to yogurt, men of an earlier time put much stock in sage. Perhaps one day an imaginative health-food entrepreneur will market a sage-flavored yogurt for those who don't like to take chances.

Bay (*Laurus nobilis*) and rosemary (*Rosmarinus officinalis*) are two other very useful and attractive herbs from the Mediterranean. In colder areas, they must be treated as house plants during winter months. South of Baltimore, Maryland, they are reasonably hardy outdoors year round. I recall growing bay in New York City for several years as a die-back shrub; top growth was killed each winter, but a new surge came from the base in spring. In mild climates, laurel is often trained into a single stem, with the top clipped into a formal globe. Rosemary thrives best in the dry, alkaline soils of the Southwest, where it sometimes makes a fine, loose, eight-foot-tall hedge. The branches take on considerable character with age, and plants lend themselves well to bonsai treatment, or at least to some pruning for special effect. Small leaves and good blue flowers add to a sense of refinement.

Bay, the true laurel of the ancients, was used to make wreaths for life's winners. Crowns of bay also conveniently covered up bald spots on the heads of Roman dignitaries. (Bay should not be confused with mountain laurel, *Kalmia latifolia,* an American shrub with vaguely similar but toxic foliage.) Bay has a summer home in the back of our herb garden. In May, we plunge it—pot and all—into the ground. Then in October, we move it indoors, prune back tops and roots slightly, and repot it. This is a vigorous shrub when it becomes established, and pruning with shears is necessary. The dense, dark green foliage serves as an enhancing background for a number of low-growing herbs. Bay brings out the best in gray-leaved plants or plants with gold or white variegation, especially the silver-leaved thymes. The leaves are intensely aromatic, and just one or two are sufficient for flavoring a stew.

Rosemary means dew of the sea, an allusion to the plant's home on the shores of the Mediterranean. It is the herb of remembrance as well as of love, death and eternity. In the garden, rosemary is accustomed to a hot, dry spot once it is established; in the home, it is easy to kill inadvertently, since one tends to forget to water those plants with low water requirements. During summer, we give it the same outdoor treatment as bay, but I also like to keep rosemary as a potted plant on the terrace. That way, it is easier to keep an eye on its somewhat wayward growth habit and make corrections with pruning shears. There is even a prostrate form of rosemary that is quite seductive if allowed to drape over the side of a pot. The trimmings are, of course, classic accompaniments for pork and lamb. They make especially handsome whiskers for a suckling pig, too.

New Plant Varieties

Margaret E. Sanders

The word throughout the industry is that the 1986-87 *Florida Foliage Locator* has just recently been released. There are several new plant varieties that have been introduced in this year's *Locator* that haven't been seen before. Selected for the review were some of the more popular varieties that are gaining rapid recognition with growers in the state.

Radermachera sinica

Radermachera, also known as the 'China Doll', is a new plant, which can be grown very well as an indoor foliage plant. It is a relatively new plant to Florida, growing mainly in Europe and in Hawaii. *Radermachera sinica* is native to India and China.

Some growers of *Radermachera* say that it looks like an aralia, though it is a member of the Bignoniaceae. It grows rapidly from seed or cutting. It will grow well in full light, but if grown in the shade it must be watered well or it will develop leaf drop.

Few problems in *Radermachera sinica* have been found as yet. They have a susceptibility to iron deficiency, are sensitive to root nematode and the sap may be irritating to some skin. No troubles have been found with mites and very few problems with mealy bugs. Cold weather doesn't seem to bother *Radermachera* too much, as it is a hearty, cold-tolerant plant.

About ten years ago, it was *Schefflera arboricola* that was a novelty item that grew to be extremely popular. *Radermachera sinica* seems to be following in its footsteps. Its popularity is gaining, with more and more growers ultimately realizing the potential and range of this plant.

Photo courtesy of Tropical Ornamentals, Delray Beach, Florida

Radermachera sinica *'China Doll'*

Reprinted with permission from Florida Foliage, *September 1986.*

Heliconia

Heliconia has been called the 'fake bird of paradise' because the flowers somewhat resemble those of the bird of paradise, *Strelitzia reginae.* The flowers of *Heliconia* are less massive than those of the bird of paradise and the bracts, the leaf-like section located beneath the flowers, are brightly colored. Though it has shown much promise in the cut flower crop, its use in interiorscapes is growing.

The foliage of *Heliconia* is attractive with long stems, reddish or multi-colored foliage that is banana-like. For use in the interior, some of its positive attributes are attractive flowers that bloom continuously, few insects and disease problems. Two of the more popular heliconias are 'Golden Torch' and 'Andromeda.' 'Golden Torch' is probably more readily available, being produced through tissue culture propagation and through availability in the Caribbean. For those wishing to obtain more information on *Heliconia,* contact Dr. Tim Broschat at the Agricultural Research and Education Center, Fort Lauderdale, Florida.

Nephrolepis exaltata 'Dallasii'

Nephrolepis exaltata 'Dallasii', otherwise known as the Dallas Fern, looks somewhat like its counterpart, the Boston Fern, except that it keeps its compact shape and fullness and the fronds of the Dallas Fern are shorter with darker foliage. This plant thrives in the interior and tends to do better in a dryer environment. The low-light, low-humidity fern is being used more and more because it can handle neglect, it doesn't dry out with an air conditioner in use, and it is easy to maintain.

The Dallas Fern is ideal as a potted plant, though more interiorscapers are using it as ground cover because of its dense growth habit. This foliage plant grows quickly in the nursery and higher light, but performs well as a houseplant. No problems have been discovered with the Dallas Fern with insects or diseases. The only real problem found with the Dallas Fern is the tendency of interiorscapers to overwater it.

Nephrolepsis exaltata *'Dallasii'*

Photo courtesy of Genesis West, Dallas, Texas

Anthurium 'Lady Jane'™

Photo courtesy of Oglesby Nursery, Inc., Hollywood, Florida

Dieffenbachia 'Alix'™

Originally developed in France, this vigorous, closely related version of *Dieffenbachia* 'Tropic Snow' is making headway throughout the foliage industry. *Dieffenbachia* 'Alix'™ is a shorter version of 'Tropic Snow,' but has similar colorations and markings. 'Alix'™ is a self-suckering plant, so that one plant can make a pot look filled while 'Tropic Snow' has a solitary stem. Very few problems have been found with 'Alix'™.

Transporting *Dieffenbachia* 'Alix'™ has proven to be quite an easy task. Because of its heartiness and compactness, 'Alix' can be shipped in sleeves and with very little breakage. 'Alix' is rapidly becoming known for its excellent indoor use due to its low-light tolerance and short shape.

Anthurium 'Lady Jane'™

This lovely, medium-height, low-light foliage plant with its beautiful rose-pink flower can be used in place of spathiphyllum. *Anthurium* 'Lady Jane'™ is very attractive with its dark green, thick-leaved foliage, along with its clustering flowers.

'Lady Jane'™ is a non-seasonal foliage plant. It blooms well in a greenhouse environment and is floriferous in both summer and winter. It comes from a hybrid of unknown origin. In production *Anthurium* 'Lady Jane'™ is slower growing than *Spathiphyllum*, but will hold its blooms better in the interior environment.

Diffenbachia *'Alix'*™

Photo courtesy of Ed Clay, Tropical Ornamentals, Delray Beach, Florida.

Elms of Yesterday *and Today*

The search continues for a replacement (and cure) for the American elm

Harrison L. Flint

To those of us familiar with the American elm, it is like an old friend. We know its weaknesses all too well, but we love it nevertheless. This majestic tree is prey to both Dutch elm disease and phloem necrosis, the latter a viruslike infection of woody tissue. Either can be fatal, and together they can wipe out entire stands of elm, as they have in much of the Midwest. In such areas we tend to forget that even a healthy American elm has its problems. Its buttressed trunk and shallow roots are a nuisance in small-scale plantings. Elm wood—notoriously resistant to ax and splitting wedge—breaks easily off the trees in ice storms because the crotch angles of the branches, being narrow, are weak. In a bad year, elm leaf beetles can all but defoliate the handsomest tree, and *Ulmus americana* is susceptible to a host of lesser plagues as well. Unlike Shakespeare's Julius Caesar, its faults have been interred with its bones, while its regal image lives on in photograph and memory.

Despite its flaws, the tree has undeniable appeal. It tolerates poor soil, is easy to raise, and grows rapidly, up to 100 feet tall and approaching that in breadth. Its useful range extends from Florida to Quebec and westward to the Great Plains. At maturity, with its high, urn-shaped canopy of foliage, the American elm is a stately figure in the landscape.

If you own a house and garden in the eastern half of North America, sooner or later you are likely to be faced with either preserving or removing a declining American elm. Given the problematic and complicated nature of Dutch elm disease, the homeowner may well be forced to replace the tree with either another species of elm or another type of tree altogether (unless, of course, your community has a rigorous Dutch elm disease-control program).

There are between 15 and 30 species of elm, depending on who's counting, and only 2 have consistently shown high disease resistance: lacebark, or true Chinese elm (*U. parvifolia*), and Siberian elm (*U. pumila*). A note on nomenclature: both these species are called Chinese elm. Though "lacebark elm" is a somewhat artificial common name, rather recently coined (normally common names arise from long-term, popular usage), in this case it will probably reduce the confusion.

Lacebark elm is found in China, Japan, and Korea. Owing to its wide geographic range, it is highly variable, though much of that variation has not yet been introduced to North America. Trees thrive in cultivation here from southern Florida and Texas to areas as cold as USDA Zone 5b, where the average annual minimum temperature is −10 to −15 degrees

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Reprinted with permission from Horticulture, *July 1986.*

With its high, urn-shaped canopy of foliage, the American elm lives on in photograph and memory. Despite the tree's flaws, it is easy to see why so many were planted.

Quercus virginiana *is slow growing with a broad canopy. This oak is evergreen and one of the most majestic for mild climates.*

Fahrenheit. Exploration in northern China may yield lacebark elms that are more cold-hardy than trees of that species thus far introduced into North America, possibly extending the useful range of lacebark from Zone 5 to Zone 4 or even 3. Lacebark elm in North America is smaller and slower growing than American elm and is only moderately similar in form. It is a serviceable shade tree, however, with perhaps more landscape interest than any other elm; unlike most, it holds its small, leathery leaves throughout the fall in the North and through much of the winter in the southern states. Moreover, lacebark elm can be as interesting in winter as it is in summer because the dark-gray bark exfoliates, or peels off, leaving rounded, richly colored patches of creamy-tan to olive inner bark that eventually turn a cinnamon-brown. Some specimens develop this character early in life, some later, some never. There is a clear need for superior cultivars that would reliably combine disease resistance, hardiness, strong branching habit, and beautiful foliage and bark. Fortunately, this work is under way.

Lacebark elm is a mainstay in the elm-selection and -breeding programs at the U.S. National Arboretum in Washington, D.C., and the Morton Arboretum in Lisle, Illinois. From these efforts may well come the elms of the future, especially for the South and Midwest. Meanwhile, this already impressive tree is growing in popularity as we learn more about its usefulness.

It is more difficult to find good words for the other disease-resistant species, the Siberian elm, even though it is the most widely used elm in many midwestern landscapes. Siberian elm is weak, weedy, and inordinately susceptible to elm leaf beetles (*Pyrrhalta luteola*). Not to be confused with the elm bark beetle (*Scolytus multistriatus* and *Hylurgopinus rufipes*), the leaf beetle chews holes in the leaves, sometimes eating all but the skeleton, leaving Siberian elms ragged looking and even defoliated by midsummer.

Prolific seeding of Siberian elm accounts for many trees that were never intentionally planted. Such "volunteers" sometimes become an integral part of landscapes; most become a problem. The prolific reproduction of this tree ensures that even without human

help its numbers will increase, yet the staying power of individual trees is poor. A few large Siberian elms can be found, but most succumb to the ravages of ice and wind rather early in life, creating a persistent and expensive nuisance in most areas.

But the Siberian elm does have its good qualities. Its hardiest individuals withstand temperatures of −40 degrees and colder, and for an elm it is quite tolerant of heat and drought. Because of its remarkable ability to adapt to extremes of temperature and moisture, it is one of relatively few trees that will grow successfully in the Great Plains.

'Sapporo Autumn Gold' is a hybrid of Siberian elm, probably by Japanese elm (*U. davidiana* var. *japonica)* released by the University of Wisconsin in 1973. This hybrid, reminiscent of some of the more upright clones of American elm, has potential for the landscape but is not yet widely planted. Thus far it has shown high disease resistance and greater strength than typical Siberian elm, but it will be some time before its full character is known. A more recent Wisconsin release called 'Regal' has shown early promise as a street tree, though it does not have the American elm's form.

Other species of elm show lesser or uncertain degrees of resistance to Dutch elm disease yet include highly resistant individuals that should prove useful in developing new cultivars. The earliest resistant elm cultivars were selections of the European smooth-leaved elm (*U. carpinifolia*). The first was 'Christine Buisman,' introduced in 1939. This species is far different in its growth habit from American elm, and it has not been widely accepted here. Two slow-growing cultivars, 'Koopmanii' and 'Umbraculifera,' have also shown good resistance. Both are globelike in form and remain under 30 feet in height for many years. They have proved useful for planting under utility wires but are not readily available.

Breeders at the USDA Nursery Crops Research Laboratory in Delaware, Ohio, have developed hybrids between *U. carpinifolia* and other elm species, culminating in the 1983 release of two promising selections. 'Homestead' is a complex hybrid of Siberian elm and another hybrid, which was derived from the smooth-leaved and other European species. It is densely pyramidal in form (more like a red maple than an American elm), fast growing, and initially hardy at least to Zone 5a. 'Pioneer', another cultivar, was selected from a cross between smooth-leaved and Scotch elm (*U. glabra*). In early trials it has proved similar to 'Homestead', having a more distinctive, dense, and spreading habit. Yet neither of these selections can be considered a substitute in form for the American elm. Their acceptance will be determined by their mature character, when it is known in a couple more decades, and their adaptability and disease resistance over the long haul.

Meanwhile, the search for more disease resistance in the American elm continues. The National Parks Service in Washington has identified a resistant American elm clone and is replanting the Capitol Mall and other areas in the District of Columbia with this clone and other resistant elms. Researchers are also studying lesser-known species such as *U. davidiana, U. laciniata, U. laevis,* and *U. wilsoniana.*

Will development of disease-resistant elms make other methods of control unnecessary? Perhaps eventually, but probably not soon. And even if that should happen there is still the possibility that the fungus or the insects that spread it will mutate into new forms that could infect trees previously found to be resistant. This is clearly not the time to give up on Dutch elm disease research.

What can the proud but perhaps apprehensive owner of an established, apparently vigorous American elm do to protect it? Before calling in the pros, first make sure your tree is indeed an American elm. It is no longer the most common species; in many places, especially the Midwest, the Siberian is now more common. If you doubt the identity of your tree, send a leafy branch to your nearest cooperative-extension office, a university's department of horticulture or botany, or a botanical garden or arboretum. Write or call ahead to find out how to prepare the sample for mailing and exactly where to send it.

The best way to preserve an elm is through what the experts call integrated pest management, simply a thoughtful mix of different

methods of pest prevention and control. Unfortunately, most of these methods are best carried out by professional arborists or tree specialists in a municipality that has a program for fighting Dutch elm disease. For starters, cooperative-extension services can usually provide a list of qualified arborists along with a positive identification of your tree.

Dutch elm disease is caused by a fungus (*Ceratocystis ulmi*) that is spread from tree to tree by elm bark beetles. Most control strategies are aimed at the beetles rather than the fungus. First the arborist prunes away infested branches or removes or debarks the entire tree if it is beyond saving. This step significantly reduces the beetle population and removes much of the food supply for any that remain. Prompt removal of infested wood hinders the growth of new generations of beetles and also reduces the likelihood that the fungus will grow into the roots, where it can be transmitted to adjacent elms by natural root grafts.

This sounds fairly simple. But the beetles can fly at least one or two miles to establish new colonies, so nearby elms must also be checked, treated, and, if necessary, removed. That means weeding out infected *wild* trees as well as cultivated specimens. Because of this, sanitation programs work best when carried out by the entire community.

Removing large numbers of infected trees quickly enough to forestall the spread of elm bark beetles seems impossible or, at best, hopelessly expensive. Developed at the State University of New York at Syracuse, a less expensive alternative called "tree trapping" involves injecting hopelessly diseased trees and other undesirable wildlings with cacodylic acid, a fast-acting herbicide. At the same time, the tree is treated with multilure, a mixture of synthetic beetle attractants chemically similar to the pheromone compounds that receptive female beetles secrete when they begin colonization of a new nest.

Crowds of beetles flock to the treated trees, but the site soon proves unfavorable indeed, and the beetles die for lack of food: the herbicide has ruined the bark. In most wild areas, where they are not eyesores and do not pose problems, trap trees can be left to decay in place. If they are removed the wood can be disposed of in any normal way without concern for further spread of the beetles. Research on this method continues, but for many sites this technique has proved economical.

In the past, trees have been protected by spray application of methoxychlor, but some communities object, from an environmental standpoint, to the use of this insecticide. In any case, spraying alone is a waste of time and money; as an adjunct to a careful program of removing infected wood, however, it can add a further measure of control.

Injecting fungicides into elm trunks is sometimes effective in protecting a single valued tree, but this expensive method can only be justified in sites where the risk of Dutch elm disease is high and where infection has not already progressed far.

Recently, strains of a bacterium were found that make antifungal substances. When researchers at Montana State University injected *Pseudomonas syringae* into elm trunks the bacteria persisted, preventing development of a Dutch elm disease fungus subsequently introduced to the tree. Researchers were even able to reverse infection in a few cases.

Pseudomonas syringae, by the way, is the same organism that causes leaf-spot diseases in ash, oak, poplar, walnut, willow, and stone-fruit trees, as well as lilacs, forsythias, hibiscus, and roses. The disease is largely controlled by the weather and is more severe during cool, moist springs. It seems unlikely that injecting it into the *wood* of elms would escalate *leaf*-spot diseases in other trees and shrubs, but this method is still experimental. Other researchers in the U.S. and Canada have had only mildly encouraging results, but injecting *P. syringae* along with systemic fungicides has potential; bacterial injection may yet prove an effective and inexpensive method of controlling Dutch elm disease.

One the greatest obstacles to preserving the American elm is the cost. Yet it may be neglect of trees, and the subsequent need for expensive removal, that breaks the bank. In the mid-1970s researchers at the U.S. Forest Service's Northeast Forest Experiment Station studied disease-control programs in 39 cities. They found that good control programs cost 37 to 76 percent less than tree removal and

replanting in communities without effective programs. More cost-effective methods are available today than were 10 years ago, and still others, such as bacterial injection and trees with greater resistance, may be available in the future.

I should mention that, in addition to American elm, the list of elms susceptible to Dutch elm disease includes several other North American natives and a few European species that have long been planted here, especially in the northeastern states. Few of the natives are cultivated. The winged, or wahoo, elm (*U. alata*) of the southeastern states is a small tree occasionally used in naturalized landscapes. Red, or slippery, elm (*U. rubra*) shares much of American elm's wide range and has a similar but less distinguished growth habit. September elm (*U. serotina*), of the south-central states, is a broad-headed tree of medium height, flowering in autumn, unlike other native elms. The taller but slower growing rock, or cork, elm (*U. thomasii*) ranges sparsely over much of the northeastern quarter of the United States and a little of adjacent Canada.

Ulmus parvifolia, *laceback elm, is smaller and slower growing than American elm and only moderately similar in form.*

Cedar elm (*U. crassifolia*) is more widely used as a landscape tree, especially in its native lower Mississippi River basin in Texas. So far there is little reason to hope that it will prove very resistant to Dutch elm disease and phloem necrosis. Scotch, or Wych, elm (*U. glabra*), with a natural range not greatly different from that of its fellow European, the smooth-leaved elm, shows even less disease resistance. It is seldom planted in North America today but has been the parent of some interesting hybrids.

Camperdown elm, probably a hybrid of smooth-leaved and Scotch elm, is not resistant to Dutch elm disease either. The disease and other ailments have greatly reduced the large number of these handsome specimens that once dotted parks and estates throughout the Northeast—left over, I imagine, from zealous sales efforts early in this century. English elm (*U. procera*) was brought to the 13 colonies and soon became a popular shade tree. As with American elm, its susceptibility to Dutch elm disease has discouraged new plantings. European white elm (*U. laevis*) is the European counterpart of American elm, closely related botanically and similar in appearance. Limited research has shown it to be generally susceptible to Dutch elm disease, but potentially useful, resistant individuals may yet be found.

Although the outlook may seem bleak for the American elm, there are grounds for optimism. Much sophisticated research on Dutch elm disease is going on, and much progress has been made. Many elms have survived the early decades of investigation, when competent study was periodically upstaged by claims of cures that proved to be bogus.

Whether or not a genuine cure for Dutch elm disease is ever found, experience should have taught us by now that relying on any one kind of tree is not a good idea. Even if we had a fully effective remedy for Dutch elm disease today, it would be foolish to depend as heavily on American elm, or any other elm, as we have done in the past. Large-scale monocultures invite large-scale problems.

The accompanying chart (see page 44) suggests some alternatives to American elm outside the genus. These trees are not replacements for American elm in any complete sense; none combines its elegant form with

INSTEAD OF ELMS: SOME HIGH-CANOPIED SHADE TREES

Name	Useful Range*	Native Range	Notes and Comments	Ht. and Spread at 20 Yr.(ft.)**	Ht. and Spread at Maturity	Years to Maturity
Acer saccharinum Silver maple	3a–9a	Most of eastern U.S. and adjacent Canada.	Fast growing and beautiful. Tolerates environmental extremes, but has soft wood and troublesome surface roots.	35×25	80×60	40
Acer saccharum Sugar maple	3b–7b	Northeastern quarter of the U.S., adjacent Canada, and south to Tennessee.	Moderate to slow growing. Needs good, well-drained soil. Hardwooded and durable.	25×18	75×55	70
Betula nigra River birch	4a–9a	Most of eastern and central U.S.	Fast growing. Tolerates heat and dry soil better than other birches. Grows especially well in wet soil. Handsome year-round and resistant to borers.	30×25	80×65	50
Carya illinoinensis Pecan	7a–9a	Central U.S. and south to Mexico.	Moderate to slow growing and durable. Eventually majestic and wide spreading in the South, with edible nuts and some litter.	25×18	90×75	60
Celtis occidentalis Common hackberry	3b–8b	Northeastern quarter of U.S. and south to Oklahoma and Tennessee.	Tolerates environmental extremes. Majestic and durable in the Midwest. Nipple gall and witches'broom are minor problems.	25×18	90×75	60
Fagus grandifolia American beech	4a–9a	Most of eastern U.S. and adjacent Canada.	Moderate to slow growing. Becomes a beautiful large tree within its native range. Shallow roots discourage vegetation underneath; use a light mulch.	20×18	70×60	75
Fraxinus americana White ash	4a–9a	Most of eastern U.S. and adjacent Canada.	Moderate fast growing yet durable. Seeds and seedlings are a nuisance in lawns, but seedless cultivars like 'Autumn Purple' and 'Rosehill' are available.	25×20	75×60	50
Fraxinus pennsylvanica Green or red ash	2b–9a	Most of eastern U.S. and adjacent Canada, plus Great Plains.	Similar to white ash but more tolerant of dry soil and extreme cold, with yellow rather than purple autumn foliage. Seedless cultivars 'Marshall's Seedless' and 'Summit' are available.	20×18	60×45	40

Name	Useful Range*	Native Range	Notes and Comments	Ht. and Spread at 20 Yr.(ft.)**	Ht. and Spread at Maturity	Years to Maturity
Gleditsia triacanthos Honey locust	4b–9a	South of Great Lakes, from the Appalachians through the central plains, south nearly to the Gulf of Mexico.	Large, graceful tree with fine-textured foliage that allows light to reach turf below. Planted, perhaps too liberally, in the 1950s and 1960s as a replacement for American elm. Disfigured in some areas by mimosa webworm, but the earliest selection, 'Moraine', is less troubled than newer cultivars, which are otherwise very useful trees. Only thornless honey locust (variety *inermis*) are normally used in landscapes.	25×20	80×65	50
Juglans nigra Black walnut	4b–9a	Most of eastern U.S.	Large compound leaves and large edible nuts mediate against the use of this tree where litter is objectionable. Nevertheless its is stately and durable in parklike situations. Many plants will not grow under black walnut trees.	25×20	80×65	60
Platanus occidentalis Sycamore, American plane tree	5a–9a	Most of eastern U.S. and southwest to Texas and Mexico.	Very large and fast growing, this tree is handsome in most seasons because of bicolored bark but may be disfigured by anthracnose in late spring and early summer of some years. Usually recovers later in the season. Falling twigs, fruits, and leaves make a litter problem.	40×30	85×70	60
Quercus alba White oak	4b–9a	Most of eastern U.S.	Majestic, durable, and resistant to oak wilt but slow growing.	20×15	80×80	80
Quercus macrocarpa Bur oak	3a–9a	Northeastern U.S. and adjacent Canada, southwest to Texas, northwest to Manitoba, west through the Central Plains.	As slow growing as white oak but ruggedly majestic and free of serious troubles. Exceptional among oaks for its cold and drought resistance. Becomes a large tree only in Zones 4–9a.	20×15	65×65	80
Quercus rubra Northern red oak	3b–8a	Eastern North America: Nova Scotia to Minnesota, south to Georgia and Arkansas	Moderately fast growing for an oak yet durable and tolerant of dry soil. Good in many urban sites but susceptible to oak wilt, a problem in some areas.	25×20	65×65	50

Name	Useful Range*	Native Range	Notes and Comments	Ht. and Spread at 20 Yr.(ft.)**	Ht. and Spread at Maturity	Years to Maturity
Quercus shumardii Shumard oak	6a–9a	Southeastern U.S. to Texas, north to Indiana	Moderately fast growing yet durable. Similar to *Q. rubra* except taller at maturity, with a higher crown.	25×20	80×45	60
Quercus virginiana Live oak	8b–9b	Southeastern U.S. to Mexico	Slow growing and not as tall as some other oaks, but with a broad canopy, this evergreen oak is one of the most majestic trees for mild climates.	18×15	60×100	100
Zelkova serrata Japanese Zelkova	5b–9a	Japan	Handsome and similar in growth habit to American elm but much slower growing, not as tall at maturity, and less cold-hardy. 'Village Green' is more cold-hardy than average for the species, has good form, and is relatively fast growing.	20×18	70×65	80

*USDA Hardiness Zones. See Temperature Equivalents chart on page 55, in widely ranging tree species, a single cultivar or seed source can seldom be expected to perform well throughout the entire useful range. With native species, use local material whenever possible.
**Approximate sizes given for trees growing in full sun and good soil. —*H.L.F.*

its rapid growth and adaptability to almost all of eastern North America. And, of course, each has its own particular needs and limitations, and one that seems trouble-free today may develop major problems tomorrow. All develop a high canopy of foliage, however—some relatively quickly, others at maturity. Among them are many a good deciduous tree that would prove suitable for that place in the yard where the elm used to be.

Celtis occidentalis, *common hackberry, is a majestic and durable tree for the midwest and northeast.*

The Urgency of Tropical Conservation

Peter H. Raven

Sharing the planet Earth with us are at least four to five million species of animals, plants and microorganisms, most of which are poorly known. About two-thirds of them have not even been given scientific names.

Of all the world's species, roughly ten percent occur in the United States and Canada together. We can state with confidence that most of these plants, vertebrates, and larger invertebrates and fungi have been studied and classified. Furthermore, we now know that some 5 to 10 percent of North America's species are threatened or endangered, and we are making advances in protecting them.

But to think that by "taking care of our own" we are saving a large proportion of the world's organisms is to delude ourselves. It is to the tropics that we must turn. For instance, about a third of the total number of Earth's plants, animals, and microorganisms occur in Latin America. Of these, only about a sixth have been catalogued. Of the remainder, amounting to nearly 30 percent of all the planet's organisms, we know absolutely nothing. Some scientists, including Terry Erwin of the U.S. National Museum of Natural History, have estimated that the total number of species in Latin America might be much higher. His calculations indicate a regional total of perhaps 15 million species. But whatever the final figure, the number of unknown species is staggering.

For example, South America's fresh waters are inhabited by an estimated 5,000 fish species, only about 3,000 of which have been named. (This amounts to about an eighth of all the world's fish species.) On the eastern slopes of the Andes, 80 or more species of frogs and toads often exist within a single square mile—almost as many as in all of temperate North America. Approximately the size of the state of Colorado, Ecuador harbors more than 1,300 species of birds—roughly twice as many as those inhabiting the United States and Canada.

The destruction of tropical moist forests is disastrous and probably accelerating.

Moreover, hundreds of *new* species of plants—including many dozen tree species—are being discovered in Latin America every year, as are dozens of new species of terrestrial vertebrates and fishes. Over a third of the nearly 800 species of reptiles and amphibians known to occur in Ecuador have been discovered since 1970, and many more are still being found there. In fact, the three northern Andean countries of Colombia, Ecuador, and Peru combined are home to about a sixth of all the Earth's biota—some 750,000 species that are also the most poorly known organisms on our planet.

Such richness, paired with a lack of knowledge, makes it imperative that biological surveys like The Nature Conservancy's conservation data centers be initiated in all the countries of the tropics. Only with continuously updated biological information can the people of any country take appropriate steps to preserve and wisely use their nation's species and natural ecosystems.

The actual and potential importance of spe-

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Photos courtesy of Missouri Botanical Garden.

Areas in which the tropical forests have been most heavily cleared include Mexico, the West Indies, Central America, the Andean countries of South America.

cies for human welfare cannot be overstated. About 85 percent of our food is derived directly or indirectly from 20 species of plants, and some 60 percent comes from only three: corn, wheat, and rice. It stands to reason that among the world's remaining estimated 235,000 known flowering plant species, there must be many more that could provide important sources of food—not to mention medicines, oils, chemicals, and sources of renewable fuels. Our continued survival depends on our ability to use plants, animals, and microorganisms extensively and wisely. Yet we know absolutely nothing about most tropical organisms, and we certainly haven't examined them for their potential value to humans. By saving the tropical forests and their myriad plant and animal species, we also will be investing wisely in the future survival of our own species.

But despite its riches, tropical vegetation worldwide is being altered or eradicated at an alarming rate. In 1981, the Tropical Forest Resources Assessment Project of the United Nation's Food and Agriculture Organization (FAO) estimated that 44 percent of the tropical rain forests had already been degraded or destroyed by 1980. Currently—according to an international task force sponsored by the World Resources Institute, The World Bank, and the United Nations Development Programme—27 million acres (an area larger than Austria) of tropical forest are being cleared each year. This is some 50 acres per minute. (The task force has launched an $8-billion campaign to reverse tropical deforestation by 1991.) If present trends continue, the rich tropical moist forests of many developing countries will disappear in the next two to three decades.

Whatever the estimates, the destruction is disastrous and is probably accelerating because the population in tropical countries is growing so rapidly. Since 1950, the number of people in tropical and subtropical countries has grown from 1.1 billion to approximately 2.5 billion. With 80 million people added each year, this population alone is projected to reach about 5 billion—equal to the entire globe's current population—within 35 more years.

With no other options for feeding their families, the estimated 1 billion people of the tropics living in what The World Bank defines as absolute poverty are consuming the forests. They clear it a couple of acres at a time, cultivating small patches for a few years and then moving on when the generally poor soils have been depleted. (Many tropical soils—and most of those in Latin America—are acidic and infertile; they cannot be cultivated on a sustainable basis.) Areas in which the tropical forests have been most heavily cleared or degraded include Mexico, the West

Indies, Central America, the Andean countries of South America, the southern and eastern fringes of the Amazon, all of Africa and Madagascar (outside the Zaire Basin), and all of tropical and subtropical Asia.

The human consequences of this devastation are profound. Famine in the tropics stems directly from overpopulation and overuse of resources, with the effects of droughts simply being amplified by the existing conditions. Political instability is widespread in the tropical and subtropical countries. The nations of the developed world will be less and less able to interact with these countries until they attain stable populations, provide reasonable expectations for their poor, and deploy sustainable agricultural and forestry practices throughout their lands.

The greatest consequence of all, however, is that of biological extinction—the extermination of a major fraction of Earth's plants, animals, and microorganisms during the lifetimes of most people living today. Many tropical organisms are very narrow in their geographical ranges and highly specific in their ecological requirements. At least 40 percent of the world's species occur in the very tropical forests that may not survive the next few decades. The loss of only half these organisms would amount to the permanent disappearance from our planet of at least 750,000 species—a far greater number than the *total* number of species found in the United States and Canada. If we wish to preserve the world's biota, can it be doubted that our major concern in the closing years of the 20th century and the early years of the 21st century must be with the tropics?

In areas such as Madagascar, coastal Ecuador, and the Atlantic forests of Brazil, all of which have lost more than 90 percent of their natural vegetation, extensive extinction has undoubtedly already occurred. The ecological theory of island biogeography predicts that a decrease of an area to a tenth of its original size should eventually result in the extirpation of half its species. Each of the three areas just mentioned is believed to harbor roughly 5,000 endemic plant species, as well as perhaps 100,000 endemic species of organisms of all kinds. Thus, we can estimate that in all three areas combined perhaps 150,000 species of plants, animals, and microorganisms have already been extirpated or are presently vanishing from their small remaining islands of vegetation. Projecting these figures throughout the world—and keeping in mind the totally inadequate state of our knowledge of tropical organisms—we can estimate that some 750,000 species will become extinct over the next few decades. This amounts to a loss of several species each hour.

To find an extinction event of this magnitude in the geological records, one needs to go back some 65 million years to the end of the Cretaceous Period when—possibly spurred by a cloud thrown up by the collision of a gigantic meteorite with the earth—a large proportion of the Earth's organisms, including the dinosaurs, became extinct. The extinction that is taking place now will occur during our lives and those of our children. But we can ameliorate its effects by learning about tropical organisms and using our knowledge to save them. Our contribution to preserving natural diversity will be minute if we do not look beyond our own borders to the tropics. This task is one of extreme urgency. If we succeed, we shall play an important role in shaping the quality of life for all who come after us.

Tropical vegetation is being altered or eradicated at an alarming rate.

Evergreen vines from Japan are intriguing choices for warm climates

Asian natives for American landscapes

John L. Creech

Vines are most often thought of as architectural enhancements, with the plants serving as wall climbers. For this purpose, attributes such as attractive flowers, fall color and fruit are important.

An evergreen nature is another important characteristic. Except for ivy, however, evergreen vines are most likely to be encountered only in the lower South. There are several reasons for this, the foremost being that most such vines have limited hardiness. Another reason is that vines are often used to provide shade—particularly to ward off the hot sun during summer. In the North, deciduous vines serve best for this purpose as they do not block out the winter sun when it is needed.

While there are not likely to be too many additions to the rather limited list of evergreen vines with acceptable hardiness, a few less familiar vines of Asia are worth noting along with some that have been commonly grown in the lower South for decades.

Ficus pumila

The climbing fig, *Ficus pumila,* is among the most widely grown of the diminutive evergreen vines, and it serves architectural functions perfectly. In addition, it is the principal plant used to create topiaries on frames made of wire and sphagnum moss.

This plant is native to the warm coastal forests of southern Japan, down through Taiwan and into mainland China. It occupies a place in the forests of broad-leaved evergreens, scrambling up the trunks of trees in its flat, diminutive fashion until it suddenly branches out into the adult form.
Normally the leaf of the juvenile form is heart-shaped. However, while collecting in the coastal forest at Cape Muroto in southern Shikoku, I encountered a form with tiny leaves shaped like those of an ivy. I sent it back to the Glenn Dale Plant Introduction Station in Glenn Dale, MD, where it was assigned plant identification number 235261. It was propagated and was distributed to a few interested growers in the 1960s. Later on, plants were also distributed from Longwood Gardens of Kennett Square, PA.

Although my fellow collectors and I intended to formally register the new form, there was some difficulty in identification because no adult material was available. Ultimately, it was concluded to be *F. pumila* and was simply referred to as the ivy-leaved form.

Recently, I have seen this handsome small fig used as a pot plant and suspect that it is probably around in several localities. In 1976, when Skip March and I were collecting on Yakushima, we encountered a similar ivy-leaved form of *F. pumila.* It is now at the National Arboretum.

Euonymus and Trachelospermum

The most widely cultivated evergreen scandent plant of Japan is, of course, *Euonymus fortunei radicans,* the wintercreeper. The Japanese call wintercreeper "tsurumasaki," meaning vine spindle-tree.

This diminutive form of the species is scattered throughout the mountains of Japan, just reaching into Hokkaido. It occurs in a myriad of forms in the wild. In cultivation, the num-

The winter-flowering evergreen vine Clematis crassifolia *is rare in cultivation.*

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photos by John L. Creech

This Stauntonia hexaphylla *was found on Osumi Peninsula in Kyushu.*

ber of named cultivars is a reflection of this variability. In addition to the normal green type, there are no less than 10 variegated forms. My own collection from northern Honshu is a miniature form now registered as 'Longwood.'

Susceptibility to scale is the main difficulty with wintercreeper, but scale is not a serious problem if it is eradicated early. This evergreen vine is hardy to Zone 5, and some selections are satisfactory into southern Canada.

Ranking next in hardiness among the small-scale evergreen vines of Japan is *Trachelospermum,* represented by two species: *T. jasminoides* and *T. asiaticum.* In the South, this plant is called confederate jasmine, but I am not sure which species is correctly called by this name. *Wyman's Gardening Encyclopedia* says that it is *T. jasminoides.* But that plant is the less hardy of the two. *Trachelospermum asiaticum* is probably the plant that is widely cultivated under this name.

In Japan, *T. asiaticum* grows in coniferous forests—particularly in the moist *Cryptomeria* groves, where it winds up the trunks for several feet. The flowers are small, white and lightly fragrant. They appear mixed with the narrow, elliptic leaves in May. As might be expected, many variegated forms have been selected in Japan, and a good collection of these and other leaf forms are being cultivated at the National Arboretum. *Trachelospermum asiaticum* is listed as hardy in zones 7 and 8. Small plants collected in a forest north of Tokyo, not far from Nikko, have survived our two recent cold winters in western North Carolina.

A few other evergreen vines of Japan should be mentioned here, although it is not likely that they will be easy to find in the nursery trade.

Kadsura japonica is a scandent shrub with thick, glossy evergreen leaves. They have a reddish tint when young. The white flowers are inconspicuous, and only the red fruit clusters in the autumn offer anything exceptional. I have collected this plant a number of times in the evergreen forests of southern Japan and once grew several plants on a trellis at Glenn Dale, only to have them cut down by cold winters. The hardiness is probably about equal to that of climbing fig, which *K. japonica* often accompanies around the lower trunks of evergreen oaks.

Similarly, *Piper kadsura* is a tender evergreen vine of southern Japan. It resembles peperomia in leaf. It scrambles over rocks and rambles as a ground cover until it reaches a vertical support. The flowers are insignificant, but the red fruits are interesting.

Stauntonia hexaphylla is the other evergreen vine of Japan's warmer regions that merits consideration. Related to the akebias, it grows in the mountains of western Japan, where it climbs over evergreen shrubs and, occasionally, azaleas. The attractive leaflets come in groups of three to seven. The whitish flowers have fine purple striations and are especially fragrant (top photo, page 52). They appear in the axils of the leaves in May and are followed by purple, oblong berries. The fruits are probably edible; when I was collecting in Nepal where the plant also grows, the collectors would eat the flesh while gathering fruits for me.

The plant is perfectly hardy in Maryland (Zone 7), and it would be interesting to use for shade in the warmer parts of the South.

All of the vines mentioned above have been cultivated in Japan for centuries and in every instance, there are variegated and bizarre leaf forms.

During my early travels to Japan, particularly a winter trip in 1956, I encountered two interesting evergreen scandent plants. Although both were introduced successfully, they never made it past that stage in the trade.

The first of these is an evergreen clematis, *Clematis crassifolia,* which is native to the warmer parts of Kyushu and Shikoku. I encountered it in full bloom in November on the small island of Tanegashima (photo, page 50). The pure white flowers have four large, linear sepals. The interesting leaves are rather fleshy and dark green. Except for that early introduction, I doubt if *C. crassifolia* has otherwise been introduced. Since nothing else has been attempted, the plant would be worthy of additional collecting.

The other unusual evergreen vine that I found during the 1956 collecting trip was *Psychotria serpens,* a small vine that attaches by aerial roots (bottom photo, this page). In many ways, it resembles climbing fig in its flat growth habit. However, *P. serpens* is considerably more dense, and its white flowers are borne in dense clusters.

Psychotria's native range reaches from southern Japan (particularly Yakushima) down through the Ryukyu Islands and the warmer parts of China. So like other plants mentioned previously, its main use would be in America's warmest localities and in conservatories, where it should be a remarkably attractive evergreen vine.

Most of the evergreen vines are of a tropical or warm temperate origin and, as such, can only be expected to perform well under comparably favorable conditions in the US. The South needs evergreen vines, and the search for new and interesting species should be fascinating and productive. A considerable range of species in the Orient might serve this purpose, and collectors should always be on the lookout for potential candidates.

Psychotria serpens *climbs a tree trunk on Yakushima Island, Kyushu.*

Recent Books Worth Noting

In the Library of the Brooklyn Botanic Garden
(Please order directly from your bookstore, not from the Botanic Garden)

BEAUTIFUL BOOKS

Africa by Isak Dinesen. Sierra Club Books, San Francisco. $35.00
A combination of Dinesen's writings and superb color photographs evoke a feeling for the land. Lovely book.

Deerfield: An American Garden through Four Seasons by Derek Fell. Specialized Book Services, Portland, Oregon. $35.00
This beautiful book uses as its subject a private garden that is not open to the public. The garden is mainly explored with a camera—all reproduced in full color. Lovely!

The Flowers Around Us: A Photographic Essay on their Reproductive Structures by Mary Parker Buckles, photographs by Carter Harmon. University of Missouri Press, Columbia, Missouri. $29.00
Lovely book composed of beautiful color photographs and supporting text. Nearly one hundred commonly seen species of flowering plants are treated.

Minka: Traditional Houses of Rural Japan by Chuji Kawashima. Kodansha International, New York. $60.00
The "houses of the people" lie in the blending of form and material which changes with the geographic location. Profusely illustrated, this large-format book provides information for the armchair architect and interested traveler.

Salad by Amy Nathan, photographs by Kathryn Kleinman. Chronicle Books, San Francisco. $14.95
The components of a salad are described and illustrated. Beautiful photographs and recipes of different salads follow. The book is a delight to peruse.

Traditional Japanese Furniture by Kazuko Koizumi. Kodansha International, New York. $70.00
This large-format book traces the history and techniques of Japanese furniture-making through text, drawings and photographs. Beautiful book which contains lots of information.

BRITISH GARDENS AND GARDENERS

Capability Brown and the Eighteenth-Century Landscape by Roger Turner. Rizzoli International Publications, Inc., New York. $19.95
A verbal and pictorial history of the accomplishments of the remarkable Lancelot 'Capability' Brown. Also an appraisal of the present condition of each park.

Collins Book of British Gardens by George Plumptre. Collins, London, $13.95
Here is a nice guide to 200 gardens in England, Wales and Scotland. Maps, hours and brief descriptions would be valuable to the garden traveler. Handy size to pack.

Gardens in Edwardian England. Antique Collectors' Club Ltd., Woodbridge, Suffolk, England. $25.00
This book was originally published by *Country Life* as *Gardens Old and New* in the early years of this century. It is the account of sixty-six British gardens illustrated in black and white.

Gravetye Manor. Text taken from writings of William Robinson. Sagapress, Millwood, New York. $125.00
This book is a limited numbered edition with an introduction by Graham Stuart Thomas. The text is from Robinson's own writings during the period when he owned

and created the gardens of Gravetye Manor. His reflections stand the test of time.

The Illustrated Garden Book by Vita Sackville-West, edited by Robin Lane Fox. Atheneum, New York. $22.50
V. Sackville-West wrote a gardening column for the *Observer* from 1946–61. The articles in this book have been adapted from the original columns and most have not been reprinted before. This book is a pleasure to the eye and wonderful reading whether you garden or not. ". . . mid-August means the beginning of autumn . . . not that I have anything against autumn, as such. On certain days we may well be tempted to think it the most richly beautiful of seasons. It is only the portent that we deplore."

The Living Garden: the 400-year History of an English Garden by George Ordish, Houghton Mifflin Company, Boston. $17.95
The subtitle says it. Interesting reading for the garden historian. Some of the garden's four-footed inhabitants also described.

Making a Cottage Garden by Faith and Geoff Whiten. Merrimack Publishers' Circle, Salem, New Hampshire. $15.95
If creating a cottage garden is your goal, here is help. This is a book from England, however, so plants recommended must be carefully considered. Nice color photographs.

Marjorie Blamey's Portraits of Wildflowers by Marjorie & Philip Blamey. Merrimack Publishers' Circle, Salem, New Hampshire. $11.95
Beautiful illustrations by Marjorie Blamey make this book a delight to peruse. The wildflowers are those of England and Europe, however. Brief descriptions accompany drawings.

No Ordinary Gardener: Thomas Knowlton by Blanche Henrey. British Museum of Natural History. $17.50
This biography is based on original material in the British Museum. He was undoubtedly one of the outstanding gardeners of his time. Much of the text is drawn from Knowlton's letters.

The Overlook Guide to Winter Gardens by Sonia Kinahan. The Overlook Press, New York. $18.95
The author spans the months from 15 November to 15 March. Although written by a British gardener, zone maps are provided and source lists for the U.S. as well. Nicely done.

A Vision of Eden: the Life and Work of Marianne North. Published in collaboration with the Royal Botanic Gardens, Kew. Merrimack Publishers' Circle, Salem, New Hampshire. $22.95
Marianne North toured a good part of the world in the late 1800's and recorded her expedition in both paintings and in journals. Her paintings are housed at Kew and reproduced here. She had a remarkable eye for detail.

Vita's Other World by Jane Brown. Viking, New York. $20.00
Interesting biography of Vita Sackville-West. Liberally illustrated some in color with excerpts written by Vita herself. For those who love Sissinghurst, this book is a must.

FLORAL DESIGN

The Forgotten Art of Flower Cookery by Leona Woodring Smith. Pelican Publishing, Gretna, Louisiana. $10.95
Each chapter is devoted to a flower which is introduced with historical information. The recipes follow. Interesting.

Designing with Flowers by Tricia Guild. Crown Publishers, Inc., New York. $24.95
The inspiration is provided by the beautiful color photographs throughout. Lovely book.

Miniature Preserved Flower Arrangements by Maureen Foster. William Collins Sons & Co., Ltd., Toronto, Canada. $11.95
How to preserve, dry and arrange flowers and other natural material. Line drawings and color photographs help.

The New Art of Flower Design by Deryck Healey. Villard Books, New York. $25.00
Large format book filled with color photographs. The nuts and bolts information is nicely organized in the back of the book. Pleasing.

GARDEN DESIGN

Creating a New Garden by Geoff & Faith Whiten. Norton, New York & London. $22.50
The value of books like this is the diversity of ideas with excellent ones on individual garden features, along with good color illustrations. Several charming ways to incorporate water. In fact, charming is a good description. Adapted for use in North America.

Garden Projects. Arco Publishing, Inc., New York. $14.95
Garden projects include fences, walls, paving, play areas, building pools, and much more. Some projects can be done by the homeowner, but many are quite ambitious. Lots of ideas through photographs and drawings.

Gardens By Design: Step by Step Plans for 12 Imaginative Gardens by Peter Loewer. Rodale Press, Emmaus, Pennsylvania. $19.95.
Peter Loewer is a delight to read whether you build any of his gardens or not. Each garden is fully explained and illustrated by the author himself. Plant lists and sources provided as well.

Planning and Building Fences and Gates. Tab Books, Inc., Blue Ridge Summit, Pennsylvania. $14.95
Thorough treatment of the subject presented in an understandable manner. Drawings and photographs help.

Princely Gardens: The Origins and Development of the French Formal Style by Kenneth Woodbridge. Rizzoli International Publications, Inc., New York. $45.00
The subtitle says it. Mostly of interest to the garden historian—the subject is covered in depth. Illustrated in black and white.

Pursuing Innocent Pleasures: The Gardening World of Alexander Pope by Peter Martin. The Shoe String Press, Inc., Hamden, Connecticut. $29.50
This book is a history of Pope's life as a landscape gardener. The author is a garden historian who emphasizes the designs of the gardens and the people who laid them out.

Town Gardens by Gill Page. Salem House Publishers, Manchester, New Hampshire. $19.95
Small spaces may provide added challenges for design. Here are some ideas mainly conveyed through color illustrations.

GARDENING TECHNIQUES

Advances in Urban Pest Management. Edited by Gary W. Bennett and John M. Owens. Van Nostrand Reinhold, New York. $47.50
Presented here are the latest strategies and practices in managing pests.

The Amateur's Flower Garden by Shirley Hibberd, preface by Anthony Huxley. ISBS, Inc., Portland, Oregon. $19.95
This book first appeared in 1871 and it is surprising to read discussions of herbaceous borders at this early date—predating Robinson. Interesting from an historical point of view though small type makes for difficult reading.

Biological Pest Control: The Glasshouse Experience. Edited by N.W. Hussey and N. Scopes. Cornell University Press, Ithaca, New York. $25.00
Collection of papers which describe the biology of both important greenhouse pests and their natural enemies. Outlined are the history and development of these systems with information on putting such into practice.

A Book of Gardening by Penelope Hobhouse. Little, Brown and Company, New York. $29.95
This book is a guide to making a successful garden based on the techniques and experience of Britain's National Trust gardeners and advisors. Remember transatlantic translations! Pretty book.

A Cook's Garden by Jan Mahnken. Countryman Press, Woodstock, Vermont. $12.95
Sprinkled with recipes and humor this

book is entertaining reading whether you garden or not. After reading it you'll be tempted to grow your own vegetables so be prepared.

Complete Guide to Basic Gardening. Project editor, Michael MacCaskey. HP Books, Inc., Tucson, Arizona. $12.95
Well organized, attractive book which would be a good reference. The book is illustrated with color photographs which is an asset.

Denny McKeown's Complete Guide to Midwest Gardening. Taylor Publishing Company, Dallas, Texas. $24.95
Written with common sense and humor this book seems to provide the basics. One is always wary of the word "complete" on such a subject, however. All the photographs are in color which makes the book attractive as well.

Dick Raymond's Gardening Year. Simon and Schuster, Inc., New York. $17.95
The author takes the vegetable gardener through each month. Nicely illustrated with color photographs and black and white drawings. Attractive presentation.

High-Yield Gardening by Marjorie B. Hunt and Brenda Bortz. Rodale Press, Emmaus, Pennsylvania. $21.95
Thorough treatment on making the most of your garden plot from preparing the soil to extending the season. Source list and bibliography included.

Pesticides in Soil. Edited by Sarina Saltzman and Bruno Yaron. Van Nostrand Reinhold Company, New York.
A reprint of key papers and investigative landmarks with running commentaries by the editors. Presented here is a comprehensive illustration of the state-of-the-art in soil/pesticides research.

Taste Buds for Cooks and Gardeners by Jean Winslow and Edna Harvey Wolverton. Wimmer Brothers Books, Memphis, Tennessee. $12.95
Chatty combination of gardening tips and recipes arranged by the month. Spiral binding.

Time-Life Gardening Series. Henry Holt and Company, Inc., New York. $12.95
The series has now been issued in paperback.

The Weekender's Gardening Manual by Patricia A. Taylor. Holt, Rinehart and Winston, New York. $19.95
Attractive book, much of it illustrated in color. Offers garden plans, ideas for what to plant and care following. The subtitle "Easy-Care Gardens in Two Hours (or less!) a Week" makes one uneasy, however.

What Makes Crops Rejoice: An Introduction to Gardening by Robert Howard with Eric Skjei. Little, Brown and Company, Boston. $16.95
Good reading is provided by the historical aspects of gardening and design provided here. The last part of the book tells you how to do it.

Winegrowing in Eastern America by Lucie T. Marton. Cornell University Press, Ithaca, New York. $24.95
This is a survey of wine growers in this part of the country as well as history and the fundamentals of how to do it. Comprehensive text.

HERBS AND SPICES

Chinese Herbal Medicine: Materia Medica by Dan Bensky and Andrew Gamble. Eastland Press, Seattle, Washington. $60.00
A very readable encyclopedic introduction to the subject with main text arranged by ailment. Cross references to pharmaceutical names in English, Mandarin, Japanese and Korean. Excellent bibliographies. General index mainly to ailments; index to pharmaceutical names. Suffers from lack of index to botanical names.

Countryside Herbs by Rosamond Richardson. Salem House Publishers, Manchester, New Hampshire. $9.95
Covers myths, magic, use in folk medicine, cooking with herbs and other uses of 21 commonly used herbs. Illustrated with drawings—interesting reading.

English Herb Gardens by Guy Cooper

and Gordon Taylor, photographs by Clive Boursnell. Rizzoli International Publications, Inc., New York. $25.00
The authors selected 58 gardens in England. Most date within the last 50 years. A full page color photograph is faced by a general description. It is too bad that the color isn't better because it is an attractive book.

Herbs, Spices and Medicinal Plants: Recent Advances in Botany, Horticulture, and Pharmacology, Volume 1 by Lyle E. Craker and James E. Simon. The ORYX Press, Phoenix, Arizona $55.00
The subtitle says it—this is a scientific treatment of the subject. Good reference, but not for casual reading.

The Illustrated Plant Lore by Josephine Addison. Salem House Publishers, Manchester, New Hampshire. $15.95
The lore of over 300 plants is covered. Medicinal and herbal remedies, traditions, sayings and superstitions are noted. Interesting!

Magic and Medicine of Plants. Readers Digest, Pleasantville, New York. $21.99
A well-illustrated, readable and charming approach to herbs, herbal medicines, crafts and lore. Excellent index and glossary.

Spices, Condiments and Seasonings by Kenneth T. Farrell. The AVI Publishing Company, Inc., Westport, Connecticut. $55.00
Very thorough treatment to be used as a reference. People on restricted diets would find this book particularly helpful. Some of the seasoning analyses were a surprise.

Sweet Herbs and Sundry Flowers: Medieval Gardens and the Gardens of the Cloisters by Tania Bayard. The Metropolitan Museum of Art, New York, David R. Godine, Publisher. Boston. $12.95
The author answers many of the questions often asked by visitors to the Cloisters. She also provides a list of plants grown there. Charming book.

PLANT GROUPS

Azaleas by Fred C. Galle. Timber Press, Portland, Oregon. $65.00
This is *the* definitive work on the subject of Azaleas. Over 360 color photographs.

Combined Rose List by Beverly Dobson, 215 Harriman Road, Irvington, New York 10533. $7.50 ppd.
Prepared each year, this is the most complete listing of old and modern roses and where to find specific varieties available commercially.

The Complete Guide to Trees of Britain and Northern Europe by Alan Mitchell, illustrated by David More. Salem Publishers and Merrimack Publishers' Circle, Manchester, New Hampshire. $27.95
Each entry is lavishly illustrated with details such as bark, fruit, leaf shape, mature shape through the seasons. Nearly 500 species are included together with many varieties. Nice reference.

Ferns of Jamaica by G.R. Proctor. British Museum (Natural History), London. £50.00
This book records and describes 609 ferns from Jamaica. Some illustrations and drawings.

A Field Manual of the Ferns and Fern-Allies of the United States and Canada by David B. Lellinger. Smithsonian Institution Press, Washington, D.C. $45.00
Scholarly guide to the identification of ferns and fern-allies with detailed information of value to anyone interested in ferns. Some illustrations in color.

Great American Azaleas: A Guide to the Finest Azalea Varieties by Jim Darden. The Greenhouse Press, Clinton, North Carolina. $9.95
The subtitle says it! Lovely color photographs of individual flowers fill the book and will help the potential buyer make selections. Nicely done.

Hardy Geraniums by Peter F. Yeo. Timber Press, Portland, Oregon. $32.95
Cranesbills, hardy geraniums, are discussed in full in this text. Described are 110 types, but this book was written in

England so many described may not be hardy in the U.S. Some color illustrations and black & white drawings.

Hugh Johnson's Encyclopedia of Trees. Gallery Books, New York.
Lavishly illustrated in color, this large format book is good for reference. The type is very small, however.

Landscaping with Perennials by Emily Brown. Timber Press, Portland, Oregon. $34.95
Plans for a wide array of gardens for every situation along with the plants to fill them. Illustrated in black & white and color. Highly readable.

Lys DeBray's Manual of Old-Fashioned Shrubs by Lys De Bray. Oxford Illustrated Press, England. $22.95
Strictly for the English market. Excellent list of English nurseries. Six books related to American plants in a bibliography of over 60 books.

Maidenhair Ferns in Cultivation by Christopher J. Goudey. ISBS, Inc., Portland, Oregon $59.95
Introductory chapters cover growing habits and conditions plus propagation. The remainder of the book is devoted to descriptions of 167 species each illustrated in color.

Miniature Roses for Home and Garden by Sean McCann. Arco Publishing, Inc., New York. $19.95
Many new varieties of miniature roses are appearing on the market each year. The author who grows roses in Ireland makes suggestions as to how to use these little beauties to best advantage—inside and out.

Orchids From Curtis's Botanical Magazine, Samuel Sprunger, editor. Cambridge University Press, Melbourne, England $150.00
This is such an important resource that it was worth spending some time on comments:
—not *all* the orchids represented
—modern nomenclature (i.e. currently accepted)
—although some come very near to the color of samples from the original Curtis Magazines, in general, the reproductions closely approximate but don't duplicate the original—this is mainly characterized by an impression of muddiness in the reproductions.

Popular Annuals of Eastern North America 1865–1914 by Peggy Cornett Newcomb. Dumbarton Oaks, Washington, D.C. $15.00
Origins and development of many popular annuals documented. Fascinating reading.

Rhododendron Hybrids: A Guide to Their Origins by Homer E. Salley & Harold E. Greer. Timber Press, Portland, Oregon. $65.00
Intended for the rhododendron grower and hybridizer, whether amateur or professional, the book covers the pedigrees of over 4,000 hybrids and selected forms of species. Illustrated with over 600 color photographs this book is an important reference.

Solanacae: Biology and Systematics by William G. D'Arcy. Columbia University Press, New York. $72.00
Intended for the scientist, this is a definitive text on a family important to man. It contains such familiar items as potatoes, tomatoes, peppers, eggplants. Illustrated with black & white photographs and drawings.

Sulcorebutia and Weingartia: A Collector's Guide by John Pilbeam. Timber Press, Portland, Oregon. $32.95
For the collector of cacti this book covers the genus *Sulcorebutia* and the closely related *Weingartia*. Color and black & white photos illustrate this volume. In addition to descriptions of the species a general section covers cultivation, classification, geography and collecting in the wild.

Taylor's Guide to Annuals. Houghton Mifflin Company, Boston. $14.45.
Based on Taylor's *Encyclopedia of Gardening* this version has been updated and color photographs have been added. Nicely organized but somehow the single volume was easier to use. There are also in the series: *Bulbs, Perennials* and *Roses.*

Trees and Shrubs by Derek Fell. HP Books, Inc., Tucson, Arizona. $9.95
Plants illustrated in color throughout the book. Chapters on the use of trees and shrubs in the landscape, their care and selection are followed by an encyclopedia section. Beautiful photographs.

Useful Plants of Tropical West Africa, Vol. 1 by J.M. Dalziel, edited by H.M. Burkill. University Press of Virginia, Charlottesville, Virginia. $100.00
The first of four volumes which will revise and expand the original listing of all West African plants known and used by man. This volume covers families A-D. Each plant is fully described with uses and locations given. Important reference work.

REFERENCES AND MORE

Australian Plants for Your Garden by Glen & Peta Heyne. U.S. Distributors, ISBS, Portland, Oregon. $14.95
Wonderful as a guide to Australian plants. Taxonomists will find it very useful. It does not relate to U.S. gardens except perhaps California. Color illustrations.

Biology by Peter Raven and George Johnson. St. Louis Times Mirror, St. Louis, Missouri. $36.95
This is a remarkable integrated overview of biology and current biological thought—not only an intellectual gem but also an obvious labor of love that's going to set the standard for years to come.

Botanical Index to the Journal of Henry David Thoreau by Ray Angelo. Gibb M. Smith, Inc., Salt Lake City, Utah. $12.95
The title says it and the botanical index comprises the bulk of this small volume. There are several chapters of introduction and explanation.

Climates of the States, National Oceanic and Atmospheric Administration. Gale Research Company, Book Tower, Detroit, Michigan. Two volume set. $240.00
Extensive descriptions, charts, maps provide data by state on all forms of weather. Excellent reference.

Concise Dictionary of Biology. Oxford University Press, New York. $16.95
Excellent reference for the non-scientist, student and persons in scientific disciplines. Handy dictionary.

Gardening: A Guide to the Literature by Richard T. Isaacson. Garland Publishing, Inc. New York. $22.00
Written for the general gardener, this book is an invaluable resource. It lists books on various aspects of gardening with brief descriptions of each. It is not meant to be comprehensive.

Handbook of Plant Cell Culture by Philip Ammirato et al. Macmillan, New York. (around $50.00)
The first of four in a thorough, scholarly treatment of the subject with excellent references and species indices.

for the. . .TRAVELER

Beautiful Gardens Round the World by Peter Coats. Little, Brown and Company. Boston. $29.95
A pictorial survey of the "great gardens of the world" with brief descriptions. It is unfortunate that the quality of some of the photographic reproductions is not better.

Farther Afield: A Gardener's Excursion by Allen Lacy. Farrar Straus Giroux, New York. $17.95
Allen Lacy's essays are a delight to read and savor. Most of these have appeared elsewhere in slightly different form, but even a second reading brings pleasure. Good bedside book and/or winter reading.

The Gardens of Ireland by Patrick Bowe, photographs by Michael George. Little, Brown and Company, Boston. $39.95
Some twenty-one gardens are presented in this lovely book. It will be a pleasant reminder for those who have visited Ireland and a definite lure for those who have not. The text and photographs capture the essence of these fine gardens.

Gardens of North America and Hawaii: A Traveler's Guide by Irene and Walter Jacob. Timber Press, Portland, Oregon, $24.95

Fourteen hundred gardens (in the broad sense) are listed. Map and directions provided. Nice descriptions which include unusual features. Useful resource.

Held in Trust: The National Trust for Scotland by Iain Crawford. Salem House Publishers, Manchester, New Hampshire. $22.95
In Scotland the National Trust is the guardian of more than homes and estates—it is also the preserver of many magnificent wild places. The photographs are in color and quite spectacular.

The Pilot's Cross-Country Guide to National Parks by Vici & Warren DeHaan. Tab Books Inc., Blue Ridge Summit, Pennsylvania. $16.95
Here is a new slant on travel guides. Even if you don't fly a plane as the authors do, there is lots of good information on what to see in the national parks of the U.S.

WILDFLOWERS

A Guide to Enjoying Wildflowers by Donald & Lillian Stokes. Little, Brown and Company, Boston. $10.95
Field-guide size, this book covers fifty wildflowers in depth, taking each one through the seasons. Lovely illustrations accompany each.

Peterson First Guides: Wildflowers by Roger Tory Peterson. Houghton Mifflin Company, Boston. $3.95
Small field guide of 188 common wildflowers, keyed by color. This book is targeted toward the beginning naturalist. It is an abridged version of his familiar field guide.

Wildflower Folklore by Laura C. Martin. The East Woods Press, Charlotte, North Carolina. $16.95
Lovely book with drawings of 105 wildflowers grouped by flower color. Interesting reading.

The Wildflower Meadow Book: A Gardener's Guide by Laura C. Martin. The East Woods Press, Charlotte, North Carolina. $12.95
A lot is being said about meadow gardens these days without enough information provided to do it—here it is. Good solid information given for all the different areas of the country.

Wildflowers of the Pacific Northwest from Alaska to Northern California by Lewis J. Clark. Gray's Publishing, Ltd., Sidney, British Columbia, Canada. $59.95
Large-format book with color photographs of each entry. Photos do not accompany descriptions, but are keyed to each other. Handsome book.

A MISCELLANY

Bonsai Design by Peter Adams. Published by Peter Adams, Surrey, England. £7.95
Scots pine, juniper and Japanese larch are covered in step-by-step drawings with what to do through a seven year cycle. Very thorough treatment for creating bonsai.

Crabgrass Frontier: The Suburbanization of the United States by Kenneth T. Jackson. Oxford University Press, New York. $21.95
This book traces the development of the suburbs in America from their origins to the present day. Fascinating reading.

The European Garden Flora.
Cambridge University Press, New York. $99.50
This flora attempts to provide a scientifically accurate means for identification of plants cultivated for amenity in Europe. Can be of use to the scientist and gardener.

Flowers and Fruit by Colette, edited by Robert Phelps. Farrar Straus Giroux, New York. $14.95
A selection of portraits of the vegetable kingdom written in the last decades of Colette's working life are presented here. Lyrical writing.

The Formation of Vegetable Mould, Through the Action of Worms, with Observations on their Habits by Charles Darwin with foreword by Stephen Jay Gould. The University of Chicago Press, Chicago, Illinois. $11.95

Gould points out that this book is an excellent demonstration of how Darwin approached natural history in a scientific way. Gould is always a delight.

From Agar to Zehry: A Book of Plant Uses, Names and Folklore by Ron Freethy. Tanager Books, Dover, New Hampshire. $24.95
The subtitle says it. Fascinating reading and the drawings are lovely.

The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gentlemanly Specialists by Martin J.S. Rudwick. The University of Chicago Press, Chicago, Illinois. $39.95
This is a case study of the way scientific communities formulate, debate and resolve their problems.

Great Voyages of Discovery by Jacques Brossi. Facts on File Publications, New York. $35.00
The great circumnavigations of discovery reached their zenith between 1764 and 1843. This book concentrates on the botanical, geographical and zoological work of these expeditions.

How Not to Kill Your House Plants by Ann Pregosin. Collier Books, Macmillan Publications, New York. $8.95
A no-nonsense guide to caring for house plants by the co-owner of a successful plant shop. Written with a sense of humor.

The Names of Plants by D. Gledhill. Cambridge University Press, New York. $9.95
This book is in two parts: the first covering the naming of plants and how that has changed from time to time, and the second a glossary of scientific names with their meaning. Handy reference.

The Naturalist in Nicaragua by Thomas Belt. The University of Chicago Press, Chicago, Illinois. $11.95
This natural history journal has been reprinted. The original observations were made over 100 years ago by Belt who was a keen observer. The author was an English mining engineer and naturalist. Wonderful reading!

Plants that Poison by Ervin M. Schmutz & Lucretia Breazeale Hamilton. Northland Press, Flagstaff, Arizona. $9.95
Each plant is described, most illustrated, toxic parts listed, along with symptoms and poisoning. Good reference.

The Indoor Garden by John Brookes. Crown Publishers, New York. $24.95
How-to with his inimitable idea illustrations. Numerous helpful charts and illustrations of techniques.

Plants for Arid Lands by G.E. Wickens, J.R. Goodin & D.V. Field. Allen & Unwin, Inc., Winchester, Massachusetts. $35.00
This book deals with the needs of the people in arid and semi-arid lands and the possible uses of plants in those areas. It also reviews work underway in these areas.

Poisonous Mushrooms of the Northern United States and Canada by Joseph F. Ammirati, James A. Traquair & Paul A. Horgen. University of Minnesota Press, Minneapolis, Minnesota. $75.00
The book is targeted mainly toward the professional mycologists, medical practitioners and biologists to facilitate identification of poisonous mushrooms. Drawings and color photographs.

Seed Aging: Implications for Seed Storage and Persistence in the Soil by David A. Priestley. Cornell University Press, Ithaca, New York. $37.50
Author's approach to the subject is that of a physiologist and biochemist and he covers the so-called orthodox seeds.

Sonoran Desert Spring by John Alcock. The University of Chicago Press, Chicago, Illinois. $19.95
A natural history of the desert observed through a season—a fascinating tale of this strange exotic land. Good reading.

Sun Gardens: Photograms by Anna Atkins by Larry J. Schaaf. Aperture, New York. $30.00
Collected here are Atkins', recognized as the earliest woman photographer, illustrations. The subject is her large collection of seaweed recorded in a process called cyanotype (the blueprint process) which was new in 1841.

An Appreciation of Elizabeth Van Brunt 1893–1986

Last week I went to the Pierpont Morgan Library to see the amazing paper collage of Mrs. Mary Delaney. Did you see it? I hope so, because the exhibit (from The British Museum) closed last Sunday. I bought cards of some of the collages to send to Elizabeth, but somehow the sending was put off because of BBG matters which intervened, and now it's too late, or is it?

Ever since I first met Elizabeth I have had this urge to share special experiences with her, usually experiences to do with plants. She was very important to me when I first arrived at Brooklyn Botanic Garden from South Africa 26 years ago and found that I was expected to teach courses in wildflower identification—AMERICAN wildflowers, which I had never heard of, much less seen! Horrors! But it was my great good fortune to have Elizabeth as my mentor. She used to drive me in her 1950 Dodge to areas of pink lady's slippers, wild columbine, and all manner of native trees, shrubs and ferns, so that I could meet my class the following day and speak with authority about the wildflowers of Westchester. What helped me greatly was the woodland trail she maintained of plants used by the American Indians at Kitchawan, and her encyclopaedic knowledge of the subject.

That was but one small thing she did for me—another goes without saying: any knowledge I have of herbs and herb lore came directly from association with her. How well I remember her courses given both at BBG and at Kitchawan, a three-part series covered Herb Garden Tradition and Design, Plants for the Herb Garden, and Herbs in Cooking. The classes were always sold out, and fortunate students who managed to register had the privilege of hearing her many tales about herbs (the hospitalized soldiers whom she taught during World War II relating their X-rated rosemary-induced dreams; the small boy at a Flower Show telling her that Pliny the Younger wore a wreath of sage to study; her sister who criticized her housekeeping being mollified by having basil, the happy herb, slipped into her food, and the parting shot of a reform school youngster, after his visit to Elizabeth's herb garden—"Herbs sure is neat, man!") The last session of the series was always the most fun, because it was then that she could experiment with new herb recipes, and introduce old favorites, such as Sidney Smith Salad, while students chopped herbs, whipped cream, watched pots and finally washed dishes after a never-to-be-forgotten meal.

I would not only feel the need to share botanical experiences with Elizabeth, but it was wonderful to share her with people I cared for. Her hospitality knew no bounds; one was always welcome to bring friends to see her and enjoy her food and stories. At each visit there was a fresh excitement; blossoms on the climbing rose, birds nesting in the grapevine, horse chestnut fruit in the pocket to ward off arthritis.

It was easy to introduce Ian Clark to the idea of making a film for BBG on Herbs: Use and Tradition, with Elizabeth as the source. Who else would have permitted the invasion of a film-maker in her home and provided all the props? That generosity of spirit characterized Elizabeth in so many ways. Her offer of her land to BBG in the 50's was perhaps the most important manifestation of that generosity. She said she realized in church one day that in order to save the land from commercial development she should give it to a non-profit institution. BBG was looking for an outreach station at that time, and the transfer was made. Her dedication to conservation of the land saved it from the bulldozer, and consequently brought many wonderful people into the BBG extended family.

I think you know that Elizabeth was Honorary Curator of Herbs at Brooklyn Botanic Garden from 1941 until her death. She was often called upon to answer ques-

tions from BBG members and staff. And much of her expertise was put to paper when she guest edited BBG's handbook *Herbs*, published in 1950, and now in its fifth printing. Did I tell you that the June, 1987 Symposium to celebrate the 50th Anniversary of BBG's Herb Garden will be dedicated to Elizabeth's life and work with herbs. (I can see her objecting violently to this, as she did to the naming of *Magnolia* x 'Elizabeth' for her. "Praise to the face is open disgrace," she would say.)

We all have our memories of Elizabeth, and I have been happy to share a few of mine. I'm sure she knows that I was going to send her the Mary Delaney postcards, and that there will be so many things in the future that I will want to tell her about. That's why this rambling letter is "an appreciation."

—Elizabeth Scholtz

Editor's note: This letter was written by Elizabeth Scholtz at the request of members of the New York Unit of the Herb Society of America and is reprinted here in memory of Elizabeth Van Brunt.

In Memoriam

R. Milton Carleton, long-time friend of BBG, died September 3, 1986.

Dr. Carleton was guest editor of *Plants & Gardens* handbook, *Gardening Under Artificial Light*, published in 1970, and he taught courses on the subject at BBG.

His involvement in horticulture was legendary—co-founder of the American Horticultural Society, Men's Garden Clubs and president of the Chicago Horticultural Society to name just a few of his endeavors. His publications numbered in the 1,000's, he wrote many books and lectured frequently.

The Hutchinson Medal for distinguished service was awarded to him in 1959. This was only one of many awards he received during his lifetime.

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Barbara B. Pesch, *Editor*

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